

# *Refuge Notebook*

Volume 18 • 2016



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## New Refuge Visitor Center a 2015 highlight

by Andy Loranger



*Winter is a great time to visit the new Kenai National Wildlife Refuge Visitor Center.*

Almost universally, Alaskans share a ‘sense of place.’ I think this is borne out of a special pride associated with living in one of most of beautiful places on Earth, and with knowing that we not only meet, but with gusto embrace, the unique challenges that living here brings. For most Alaskans, much of this pride is deeply rooted in the opportunities we have to connect with the natural world around us—with bountiful fish and wildlife and the spectacular wild places they inhabit—and in meeting the challenges associated with developing outdoor skills.

Alaskans also know that an innate responsibility

of living here is hosting visitors, and we very much look forward to sharing our homes and lifestyles with visiting friends and family. With most, this involves sharing our passion for the outdoors. How fortunate we are that world-class opportunities to hike, fish, ski, bike, float, climb, camp, hunt and watch and photograph wildlife literally lie right beyond our front doors. And how cool is it to almost invariably hear the reaction, “wow, this place is spectacular!”

This past May, the Kenai National Wildlife Refuge opened its new Visitor Center adjacent to our headquarters on Ski Hill Road in Soldotna. From the incep-

tion of planning this new facility, our overarching goal was to somehow convey this special sense of place to visitors, young and old alike, and to highlight how the Refuge contributes to it. While no building or interpretive exhibit can ever match the ‘real deal’ of experiencing a Refuge outdoor adventure—be it an upper Kenai River float through the Canyon, landing a trophy rainbow below Skilak Lake, an overnight stay in a remote cabin, or hiking Skyline Trail—our hope was that the facility would enrich experiences by providing visitors unique insights into the natural wonders of this amazing place we call home, and encourage them to further explore and enjoy all that the Refuge has to offer.



*“Majesty of the Kenai” greets visitors to the new Kenai NWR Visitor Center.*

A tour of the new Visitor Center interpretive exhibits provides a glimpse of how the Refuge’s vast, intact and interconnected ecosystems have throughout history supported people and continue to do so today. One gets a deeper understanding of how salmon, moose, Dall sheep, brown bears and other fish and wildlife depend upon healthy alpine, boreal forest, riverine and wetland habitats on the Refuge, from Icefield to Ocean. Visitors can also garner insights into Refuge’s role in conserving our natural heritage and how challenges posed by climate change must be met to ensure that these resources enrich the lives of our children and grandchildren and continue to shape their sense of place.

We’ve been overwhelmed by the positive reac-

tions of our visitors and communities to the new Visitor Center. Several hundred people joined us for the Grand Opening ceremony in late May, and visitation in the few months since has kept us hopping and exceeded all of our expectations. Tour companies are already making the facility one of their scheduled stops, with more expected to do so next year. Our summer family Explorer and Saturday showcase programs in the new outdoor amphitheater were an immediate success. Perhaps to no one’s surprise after first glimpsing it, the bronze moose statue “Majesty of the Kenai” which greets folks at the building’s entrance has quickly become one of our area’s favorite photo stops, no doubt already gracing many photo albums.

The interactive nature of the interpretive exhibits has been a big hit, especially with families, and many have remarked about how they enjoy finding something new every time out. Visitors love to relax in the lobby, take in a film in high definition in the spacious multi-purpose room, and browse the many gift selections in our expanded Alaska Geographic sales outlet. This winter, many visitors are gathering around the masonry heater before or after hiking Refuge trails or skiing on Headquarters Lake.

In August, the Refuge was privileged and honored to be recognized by the Kenai Peninsula Tourism and Marketing Council for the new Visitor Center’s 2015 contributions to supporting the region’s tourism industry. We are also thrilled and extremely grateful that it is now quite likely that you will be greeted by one of several new volunteers at the Visitor Center’s front desk, community members who are very excited and eager to share information on the Refuge. The Refuge Visitor Center has added new dimensions and forever changed how we are able to serve the public. If you haven’t had a chance to make it out for a visit, please do soon. Next year marks the Refuge’s 75<sup>th</sup> anniversary, and we’re planning many fun programs and activities. The new Visitor Center will provide a wonderful venue for the celebrations, and we’re really looking forward to have you join us.

*From the entire Refuge staff, best wishes to all for a peaceful and joyful holiday season and a wonderful 2016. Andy Loranger is the Refuge Manager at Kenai National Wildlife Refuge. Find more information at <http://www.fws.gov/refuge/kenai/> or <http://www.facebook.com/kenainationalwildliferefuge>.*



## Christmas Bird Counts—a new family tradition

by Todd Eskelin



*Mt. Redoubt provides a scenic backdrop on the Kenai Flats, one of the more important areas visited during the 2015 Christmas Bird Count. These Trumpeter Swans were photographed in April 2006, but the conditions were identical to what was encountered during this year's count.*

As we say goodbye to our meager snow accumulation and brace ourselves for another warm week this winter, I can't help but think about what these changing winter weather patterns are doing to bird distributions. As most birders will tell you, there is a unique and excited feeling we get when we see new bird species in our area. We are always searching for the rarities while enjoying the more common species.

The annual Christmas Bird Count was held recently in the Kenai-Soldotna area. One of the highlights is always the potluck at the end of the day when birders share stories of adventures and missed steps while pursuing secretive (but cool) little brown birds

through rose thickets. The weather was perfect, the company was terrific, but this year's highlights were mostly rooted in observed changes in bird distributions which probably doesn't elicit that special feeling one gets from finding new birds.

Undoubtedly, the oddest sighting was of four Common Murres on the Kenai River near Swiftwater Park. It is not the first time that murres have appeared during the count but, on previous occasions when individuals were sighted, they were always in more appropriate places like the mouths of the Kenai or Kasilof Rivers. This year, murres are showing up all over South-central Alaska in bizarre places. Unfortunately, it appears these birds are related to a massive die-off that has been occurring from Northern California to the Bering Sea.

Die-offs are not unusual in seabird populations periodically, but the scale and magnitude of this one is unprecedented. All indications point to the persistence of warmer than normal ocean temperatures as the root cause for this massive starvation event. The "Pacific Blob" is a well-documented pocket of warm water (2 degrees warmer than normal) that has been hovering in the Pacific since 2014 and slowly moving closer to the U.S. and Canada.

While two degrees may not seem like much, it changes the diversity of zooplankton from the cold-loving crunchy forms like krill and shrimp to warm-loving more gelatinous species (squishies) that are lower in fat content and nutritional quality. Zooplankton is the food for prey fish and juvenile salmon. These small fish are in-turn eaten by millions of seabirds—even temporary changes in these cycles can result in mass starvation events like the one affecting seabirds currently.

In addition to sighting Common Murres in an odd location, record numbers of European Starlings and Rock Pigeons were also tallied in the Kenai area. These two species are very adept at subsisting around human inhabitants, so it is not a surprise that their numbers will continue to increase as the human population and footprint grow.

On a brighter note, huge numbers of Rock Sandpipers have returned to feed at the mouth of the Kasilof

River. At one point several years ago there were as many as 10,000 Rock Sandpipers feeding primarily on pea-sized Baltic Macoma clams. In recent winters, the numbers observed here were only in the hundreds but, just prior to the 2015 Christmas Bird Count, they were estimated to number 3,500. These hardy little shorebirds are from the Pribilof Island sub-species and their entire population is only estimated to be 20,000. That a large percentage of the world's population of this sub-species huddles on icebergs near the Kasilof River mouth is a blessing for bird watchers, but a great conservation concern if any catastrophes were to occur in the Upper Cook Inlet during winter.

The best sighting of all for the Christmas Bird Count occurred at the potluck after all the counting was done. People from the community showed up to share their experiences and favorite dishes at the Kenai National Wildlife Refuge Visitor Center. New birders, new families, and familiar faces all came together to talk about the time they were outside looking for birds. For some, it was the start of a new family tradition, get-

ting out as a family and taking a break from the various electronic screens that often control almost every aspect of our lives.

The event embodied the exact scenario that Frank Chapman envisioned when he started the Christmas Bird Count 116 years ago as an alternative tradition to replace the Christmas Side-Shoot. The previous event involved two teams that went out and shot every possible animal they could find in a day. At the end of the day they posed next to their respective piles and determined which team's pile was larger.

We have come a long way since then. With 2,500 counts spread from South America to Deadhorse, there are over 70,000 people who have found the new Christmas tradition just what they were looking for. Maybe we will see you and your family out at next year's Christmas Bird Count.

*Todd Eskelin is a Wildlife Biologist at the Kenai National Wildlife Refuge. Find more information at <http://www.fws.gov/refuge/kenai/> or <http://www.facebook.com/kenainationalwildliferefuge>.*

## Photographing our nightscape

by Rebecca Uta



*The low light pollution on the Kenai Peninsula allows for great photos of our nightscape.*

I recently received a gift for gracefully aging of a Nikon D3300. Being a photography hobbyist and a complete amateur, I have diligently studied our sky and landscape for something artful and amazing—not difficult here on the Kenai Peninsula. But I was swept away by our nightscape! The light pollution in much of the Lower 48 has really dimmed our night sky and our appreciation of it. Even here on the Kenai, it is impossible to set up the perfect nightscape photography unless you head out of town to find the Dark Side.

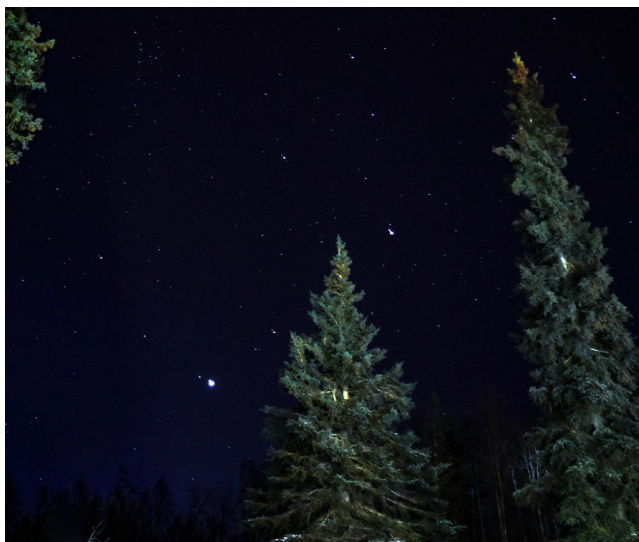
As I studied more nightscape photography tips, lens settings, ISO markers, shutter speeds, and tripod setups with remote shutter release, I quickly realized that I need to understand our nightscape. The Earth is

currently in the best position with our shortened daylight. I was challenged to learn where is the Milky Way? When is the best time to photograph it? Do I want to capture the elusive aurora borealis? Am I tracking a star trail? So few answers to so many questions.

Undaunted, I learned that we have a wonderful mix of low temperatures, low humidity, and low level of light pollution this time of year. While most people hibernate inside and common conversation surrounds cabin fever, now is the BEST time to photograph the Milky Way and the starlit blanket gracefully twinkling above us.

Here are some of my tips. New moon cycles are

the best time of the month. It is important to note the cloud cover before you head out. Check the humidity and temperature level—a high humidity will skew your photos as the water droplets in the air will create “noise” on your photos. You want the bright stars, not water in your photos. I also found some training videos that say you should run some test shots. Set your camera settings while in the warmth of your home and test them out in your backyard or the closest park. If you want to stay indoors, put a heavy hat over your lens. This trick will help you work on lowering the “noise” your camera creates.



*Starry, starry nights over the Kenai National Wildlife Refuge headquarters on Ski Hill Road on November 17, 2015. Note how bright Venus is in the lower left.*

The photos I initially took were not great: shaky, over exposed, under exposed, trails when I didn't want them, but still fun all around. The photographs offered here are two examples of night photography and how ambient light affects your picture.

For the nightscape photo, I used a Nikon D3300, AF-S DX NIKKOR 18-55mm,  $f/3.5$ , aperture 3.6, ISO-3200, focal length 18mm, Exposure +1 step. This was a quick shot without a tripod that caused the tell-tale star trails. This photo was taken behind the Refuge Headquarters building. The only ambient light was

from the door light behind me and the front lobby upstairs on the other side of the building. This small amount of light caused quite a daylight effect. Without this ambient lighting the stars would have popped even more.

For the moon photo, I used a Nikon D3300, AF-S DX NIKKOR 55-200mm,  $f/9$ , aperture 5, ISO-1600, focal length 200mm, Exposure +1 step. This photo was shot over the Refuge Headquarters complex last month. Notice the detail of the craters. When I took this shot, the raw image was not great—it was distanced, small, and over exposed. I used Adobe Lightroom to fix the image. I lowered the brightness, darkened the highlights, and increased the contrast and shadows. I also adjusted the sharpness of the edges to really bring out the craters along the moon's border. Use any photo editing software you are comfortable using, not just from Adobe Creative Cloud. Nikon had a free download with my camera's purchase. Your raw shot may not be amazing right off the click, but with a little assistance, you can really make art from your world.

If this story has piqued your interest in nightscape photography, we live in a great place for it. The Kenai National Wildlife Refuge has cabins for rent year round (<http://www.recreation.gov>) and winter camping is always available at any campsite. Find those tucked away spots that will get you away from our city lights. Prepare to spend time to set up. Remember, it's not about how many photos you take—you only need one to shock and awe.

Mark your calendars, charge your camera batteries, and join us for our Full Moon Walk & Telescope Night, Saturday January 23, at the Visitor Center, starting at 6 PM. Staff are requesting pre-registration to join the evening walk, so give us a call at 907-280-2820. If you head out on your own at night on the Refuge, think about leaving a safety plan with a family member or friend just IN CASE. And HAVE FUN! I know I do.

*Rebecca Uta is the Administrative Officer at Kenai National Wildlife Refuge. Find more information at <http://kenai.fws.gov> or <http://www.facebook.com/kenainationalwildliferefuge>.*



# Celebrating Kenai Refuge's 75<sup>th</sup> birthday in 75 ways

by Matt Conner



2016 is the 75<sup>th</sup> birthday of the Kenai National Wildlife Refuge. For fun or as a challenge, complete the checklist of 75 things to do on the refuge this year.

I've started a new tradition in our home for 2016. Every Friday night we write down something special that happened to us during the week and place it in a jar that sits on top of the refrigerator. On New Year's Eve, we will take out all those pieces of paper and read what we wrote as special and significant events for 2016.

Last Friday was our first entry and I realized I needed to set some "sideboards" as my 10 year old daughter's entry read, "I am thankful the apocalypse is not yet upon us." Knowing her sense of humor I asked for clarification if this was referencing zombie apocalypses or regular ones. She said it was an all-inclusive apocalyptic reference. Regardless of this little setback,

I am confident they will catch on and record some special memories for this year. I have little doubt that we will experience dozens of apocalypse-free experiences as living on the Kenai Peninsula presents endless opportunities for exploration!

This year is a special time for all of us to explore and learn more about what makes the Kenai National Wildlife Refuge such an amazing place. 2016 marks a very special year—it's the Refuge's 75<sup>th</sup> Birthday!

Established as the Kenai Moose Range on December 16, 1941, just 9 days after Pearl Harbor and America's entry in the WW II, President Franklin Roosevelt had a long range vision for our nation that included an ongoing conservation heritage as well as the defense

of our nation from foreign foes. In 1980, the Alaska National Interest Lands Conservation Act changed our name to Kenai National Wildlife Refuge and expanded our purposes to include conservation of the natural diversity of fish and wildlife populations and habitats on almost 2 million acres of boreal ecosystems. Congress also designated two-thirds of Kenai Refuge as Wilderness to protect the naturalness and wilderness character of this wonderful place.

National Wildlife Refuges provide both important wildlife habitats and opportunities for appropriate wildlife-dependent recreation. This year, our staff has challenged our visitors to experience what makes Kenai Refuge special. We have developed a checklist of 75 ways to enjoy the 75<sup>th</sup> anniversary. Participants record their activities on the checklist to track their progress throughout the year. The activities and challenges developed for this list are designed to enhance our visitors' experiences while learning more about the significance of Wilderness, the Refuge, and the U.S. Fish and Wildlife Service.

It is our hope that the 75 on the 75<sup>th</sup> list graces the front of refrigerators throughout many Alaskan homes this year. Perhaps we will explore new areas of the Refuge, discover new species, and learn new outdoor skills or hobbies that we will continue for many years to come. Visitors can obtain a checklist by downloading it from our website at <http://www.fws.gov/refuge/kenai/>, our facebook page at <https://www.facebook.com/kenainationalwildliferefuge/>, or pick up a copy at the Refuge headquarters or visitor center.

On the Refuge's birthday, December 16<sup>th</sup>, 2016, we will invite all who participated to attend our celebration and to share their experiences at the Refuge visitor

center on Ski Hill Road. Participants who complete 25 or more of the 75 items on the checklist will receive a special gift to remind them of their adventures on the Refuge during this special time! Our top three participants with the highest number of completed tasks will receive additional keepsakes linked to their refuge experiences.

The list provides new ideas and challenges that many of us might not have thought to try on our own. Some of the "75 items" include spend a night in a refuge cabin, learn to identify 5 native plants, attend a guided refuge photo safari, take an inexperienced angler fishing on the refuge, and prepare wild game, fish or berries within the Refuge and share your recipe! My personal favorite is "visit a ranger at the Kenai River Festival and practice fly fishing with them." This is sure to be a great time for visitors as well as Refuge staff! These ideas are just a handful of opportunities that are to be experienced as visitors check off their accomplishments throughout the year.

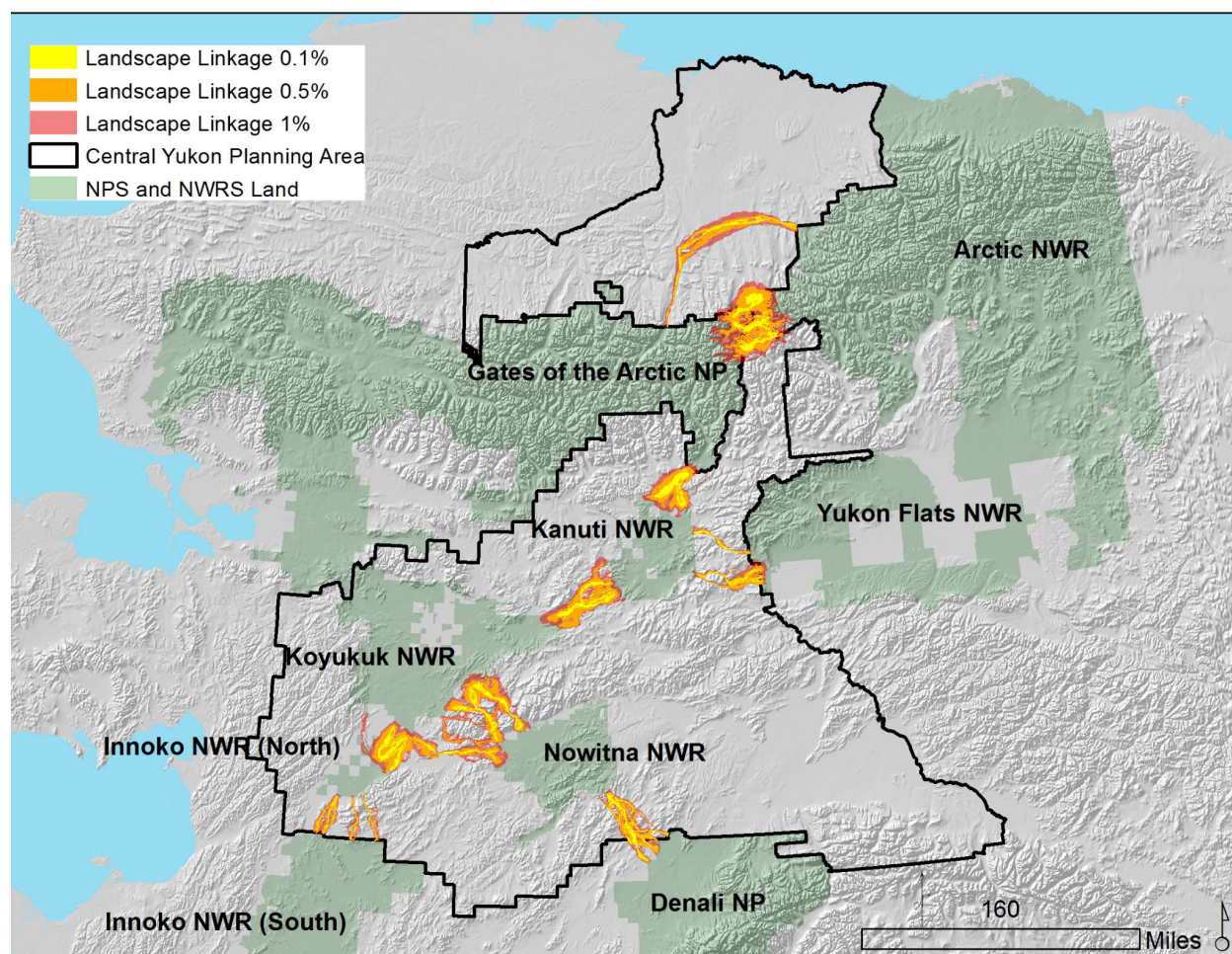
I am certain that as I sit around the fireplace on New Year's Eve this year, a great deal of our special family memories for 2016 will have come from the 75-on-the-75<sup>th</sup> list. As an employee of the Refuge I am excited to share this list of experiences with our visitors. As a father, I am ready to get started on our year of exploration with checklist in hand as we celebrate the Kenai National Wildlife Refuge during our new adventures (hopefully none of which will include a zombie apocalypse)!

*Matt Conner is the Visitor Services Manager at Kenai National Wildlife Refuge. Like the refuge at <http://www.facebook.com/kenainationalwildliferefuge>.*



# Conserving nature's stage in Alaska

by Dawn Robin Magness



*Potential landscape linkages between National Parks and National Wildlife Refuges in northern Alaska identified using an analysis of geodiversity (credit: Dawn Magness).*

The Kenai National Wildlife Refuge was established in 1981 with passage of the Alaska National Interest Lands Conservation Act (ANILCA). Prior to ANILCA, refuge lands were managed as the Kenai National Moose Range. The Moose Range was designated in 1941 by President Franklin D. Roosevelt because, as a big game hunter, he was concerned that populations of the giant Kenai moose were not being properly managed and would be overexploited.

By the 1980s, wildlife management had expanded to include concepts from the emerging field of conservation biology. Managers were thinking more

holistically about entire ecosystems rather than single species management. ANILCA expanded the purpose of Kenai Refuge to “conserve fish and wildlife populations and habitats in their natural diversity.” Diversity in this context is focused on biodiversity which includes maintaining both species diversity and genetic diversity.

Another type of natural diversity is geodiversity. Geodiversity is the diversity of enduring geophysical features such as topology, soil, and landforms. Resource managers have recently begun to focus on geodiversity as a way of responding to rapid climate

change. Before climate change emerged as a conservation issue, managers could use the current distribution of ecosystems or species for conservation planning. However, climate change requires new thinking by managers because distributions cannot be assumed to remain stable.

Plants and animals are responding to new climate conditions by moving, and ecosystems are reorganizing as species move. Paul Beier, a professor in the School of Forestry at Northern Arizona University, has suggested that managers should focus on geodiversity instead of species. Dr. Beier calls this approach “conserving nature’s stage.” Invoking William Shakespeare’s play *As You Like It*, species are the actors and geodiversity is the stage. Climate change will change the script of the play. In other words, species will shift and ecosystems will reorganize, but areas with similar geophysical characteristics should host similar species and ecosystems. Therefore, these geophysical features should be used for conservation planning because protecting geodiversity will ultimately protect biodiversity.

The Nature Conservancy has championed this conservation planning approach. Mark Anderson, a senior scientist at The Nature Conservancy, has led a research initiative using geodiversity to identify areas in the Eastern U.S. that can be used to protect biodiversity in a changing climate (<http://maps.tnc.org/resilientland/>). The Nature Conservancy has evaluated the current conservation estate in that region and, with a \$37 million grant from the Doris Duke Foundation, is purchasing lands that will provide better representation of geodiversity in the conservation portfolio.

In Alaska, ANILCA delineated a large Federal conservation estate. Approximately 130 million acres of National Park Service and National Wildlife Refuge System lands were designated in the state. Congress deliberately created large reserves to ensure that natural landscape processes remain intact because these ecosystem processes are necessary to sustain subsistence lifestyles for Alaskans.

Although we are blessed with these large and intact conservation units, Alaska is experiencing rapid and large magnitude climate change. The state is already experiencing and adapting to real impacts, such as melting permafrost, increasing coastal erosion, and loss of sea ice. Species will need to move across Alaska as conditions change. In partnership with other federal agencies, I have conducted a geodiversity analysis to identify key linkages between parks and refuges (see graphic) using a methodology developed by Brian Brost, a graduate student of Paul Beier. Coordination among agencies to maintain landscape permeability—such as building wildlife crossing structures over or under highways—could allow species (actors) to move across the conservation stage.

Here on the Kenai Peninsula, more than 4 million acres are managed by Federal agencies. The Kenai National Wildlife Refuge, Kenai Fjords National Park and Chugach National Forest form a contiguous conservation estate that is dissected by the Seward and Sterling Highways. The refuge is collaborating with the Alaska Department of Transportation & Public Facilities to construct strategically-placed underpasses so wildlife can move more freely across the 22-mile section of the highway between Sterling and Jim’s Landing. Elsewhere on the Kenai Peninsula, an interagency working group is taking a closer look at the 11-mile wide isthmus that connects the Kenai to the mainland but also bottlenecks wildlife dispersal on and off the peninsula.

Geodiversity analysis can also be used as one lens to think about whether the landscape is permeable (or not) to a wide variety of species. Maintaining connectivity between geologic features will allow species to reshuffle in a rapidly changing climate, minimizing species extinctions and ensuring resilient biological communities as our future heats up.

*Dr. Dawn Robin Magness is a Fish & Wildlife Biologist at the Kenai National Wildlife Refuge. Find more information at <http://www.fws.gov/refuge/kenai/> or <http://www.facebook.com/kenainationalwildliferefuge>.*



# How science helps manage the Kenai Refuge

by John Morton



*A brown bear leaves hair snagged on a barbed wire enclosure in June 2010. DNA from those hairs was used to help estimate the brown bear population on the Kenai Peninsula, a study published in the Journal of Wildlife Management early this year.*

Scientific research is something all of us were exposed to in school and something we hear routinely in the news. Most know that the hallmark of good science is to have findings published in a peer-reviewed science journal. But unlike the collective act of designing, conducting and analyzing data, which usually has elements of fun and excitement (especially in wildlife research), publishing can be downright punishing. From the initial submission of a manuscript to journal editors, through reviews and revisions, to having a paper reprint in hand can take one and sometimes two years. And this may be after spending years collecting data. Ouch.

So I was pleased when four articles were published recently that included Kenai National Wildlife Refuge

biologists as authors. As head of the Refuge biology program, I was even more pleased by the breadth of topics: soundscape, brown bears, earthworms and climate change. It's a kick in the pants that we have the capacity to tackle a legislative mandate as lofty as conserving fish and wildlife populations and habitats in their natural diversity.

These four articles tell us something about how science interacts with an agency entrusted with managing public lands. Spatial modeling of the winter soundscape, published in *Landscape Ecology*, reflects the Refuge's continuing response to the challenges of managing 1.3 million acres of Congressionally-designated Wilderness abutting an urbanizing landscape. Estimation of the Kenai brown bear population,

published in the *Journal of Wildlife Management*, reflects the application of new technology (DNA analysis of hairs) to solve a long-festering problem of how to count bears when you can't see them. Documenting earthworms invading our boreal landscape, published in *NeoBiota*, reflects a growing awareness of a new ecological issue in Alaska (exotic and invasive species). And the almost cosmic thinking about eco-climatic teleconnections between deforestation in Alaska and drying of the Amazon rainforest, also published in *Landscape Ecology*, shows how new perspectives arise as science matures.

These articles also illustrate how research gets done when we have neither the expertise nor the funding to study everything that needs to be studied. The brown bear study was the result of a joint field effort by biologists from Kenai Refuge and Chugach National Forest. Two papers were the results of Refuge-supported research by graduate students—Tim Mullet who received his doctorate from the University of Alaska Fairbanks (UAF) and Deanna Saltmarsh who received her masters from Alaska Pacific University (APU). In the fourth paper, Kenai Refuge was a junior partner in a much larger collaboration of researchers from universities in Michigan, Arizona, Washington, Brazil, Columbia, and the United Kingdom.

You can find these and other publications authored by biologists at Kenai Refuge since its establishment in 1941 on our website ([http://www.fws.gov/refuge/Kenai/what\\_we\\_do/science/bibliography.html](http://www.fws.gov/refuge/Kenai/what_we_do/science/bibliography.html)). We're still chasing down older literature, but more than 100 journal articles, theses and dissertations have already been compiled, many of which can be downloaded from this site.

Scanning down this list, you'll see how research has changed over the years. In the 1970s and 1980s, Refuge biologists Dr. Ted Bailey and Ed Bangs conducted seminal research on moose and trumpeter swans, examining in detail their habitat use and demographics. Dr. Bailey's 1986 article on lynx demographics helped set the current regulatory structure that adjusts allowable harvests based on the snowshoe hare population cycle. *Wolves of the Kenai Peninsula*, a monograph coauthored by Bailey in 1984, is now considered a classic read for anyone interested in wolf ecology.

In the 1990s, Refuge ecologist Dr. Ed Berg, working with graduate students Brandon Miner and Andy De Volder from APU and Northern Arizona University (NAU), studied wildfire history and its effects using

tree-ring analysis of burn scars and carbon-14 dating of charcoal. I suspect we are one of the few places in the U.S. with historic fires mapped back to the 1700s. Berg wrapped up his work on fire and spruce bark beetle with two synthesis papers published in 2006.

In the 2000s, Berg began working with other APU and University of Alaska Anchorage graduate students to link recent climate warming to rising treelines, drying wetlands and closed-basin lakes, and carbon cycling in wetlands. Working with others including Dr. Dick Reger, a local geologist, and Dr. Scott Anderson at NAU, Berg helped map the glacial retreat since the Wisconsin Ice Age while examining pollen and charcoal in peat cores to show how wildfire and plant colonization interacted in past millennia to shape our Kenai landscape.

I've also sustained a string of graduate students over the last decade from UAF, APU, Colorado State University, University of Wisconsin and University of Delaware who probed contemporary Refuge issues: American marten colonization of the Kenai Lowlands, terrestrial arthropod diversity, managing climate change in the National Wildlife Refuge System, local perceptions of bears on the Kenai, shorebird use of Chickaloon Flats, winter soundscapes and exotic earthworms. Dr. Dawn Magness and Matt Bowser, two of those graduate students, now work at the Refuge where they ply their skills in spatial modeling and entomology.

Science ultimately provides the information for management decisions and to understand ecological processes and patterns, even while identifying new issues not yet recognized by the public or resource managers. Publishing our research in peer-reviewed journals is one rigorous measure of our success in providing that information. But our goal is also to disseminate that information to non-scientists and so we write reports (aka "gray literature"), publish brochures such as the bird checklist for the Kenai Peninsula, give presentations both locally and at national conferences, and write Refuge Notebooks such as this one. My hope, through greater understanding, is that we more fully appreciate what a wonderfully complex natural world lies within the boundaries of Kenai National Wildlife Refuge.

*Dr. John Morton is the supervisory biologist at Kenai National Wildlife Refuge. Find more information at <http://kenai.fws.gov> or <http://www.facebook.com/kenainationalwildliferefuge>.*



# Climate change does not bode well for snowshoe hares

by Ted Bailey



*White snowshoe hares in a snowless landscape are more likely to be predated (credit: Cindy Goeddel Photography).*

Ever wonder what happens to snowshoe hares when they seasonally molt from their brown to their white winter coat well before the winter snow arrives or does not arrive at all and melts early? White blobs on a brown or green landscape. I wondered about this mismatch but researchers from the University of Montana and North Carolina State University not only pondered this question but began detailed observations of snowshoe hares in the Rocky Mountains of western Montana in 2010 to find out.

In one part of their studies they visually checked 148 radio-collared hares once a week to determine the coat color of hares and match it with the hare's surroundings. They discovered that the initiation of color change in the fall was fixed for hares and the rate of color change from brown to completely white took about 40 days.

However, the rate of color change from white back to brown in the spring was more plastic with the time of molt completion varying up to 19 days dependent on the duration of snow cover and individual hares. They also modeled the then current (2010-2012) snowpack duration at their study sites relative to the recent past and predicted winter snowpack would decrease by 29-35 days by mid-century and 40-60 days by the end of the century. This shorter duration was largely the result of reduced spring snow cover.

Initiation of color molts among hares was triggered by daylight length (photoperiod) not temperature, a fact already well known that can also cause seasonal changes among other species of animals. They concluded that without an evolved shift in the initiation of seasonal molt, color mismatch of white snowshoe hares on brown snowless backgrounds will increase as much as four-fold by mid-century and eight-fold by late century. Although they wondered how this shorter duration of snow cover affected the hares, they found no evidence that hares perceived their own color mismatch nor took action to shift their hiding places or changed their flight behavior responses to compensate for their conspicuousness.

Predation typically accounts for 85-100 percent of mortality in snowshoe hares. Not surprisingly, color-mismatched hares die at higher rates than color-matched hares. By observing a total of 186 radio-tagged hares in two study areas each week from 2009 to 2012, these researchers discovered that hares whose coat color mismatched their backgrounds experienced up to 7 percent decreased weekly survival rates compared to color-matched individuals. They concluded that "in the absence of adaptive response, we show that these mortality costs would result in strong population-level declines [of snowshoe hares] by the end of the century. However, natural selection acting on wide individual variation in molt phenology might enable evolutionary adaptation to camouflage mismatch. We conclude that evolutionary rescue will be critical for hares and other color molting species to keep up with climate change."

Locally, future snowpack projections by the Alaska Climate Science Center which included the Kenai Peninsula showed (1) that from October to March and between sea level and about 1,600 feet, the number of precipitation days that fall as snow will decrease by 23 percent from historical levels; (2) the snow water equivalent will decline most in the autumn (October and November) and at elevations lower than about 5,000 feet; and (3) that the percent of the landscape dominated by snow will decrease.

Based on the Montana snowshoe hare studies and the declining amount and duration of projected snow

cover in our region, snowshoe hare populations on the Kenai Peninsula face an uncertain future in the coming decades.

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*terest in the Kenai Peninsula's wildlife and natural history. Find more information about the Refuge at <http://kenai.fws.gov> or <http://www.facebook.com/kenainationalwildliferefuge>.*



## Fighting the good fight against invasive weeds

by Jen Peura



*Kelsey Hass, part of a 2-person strike team hired by the Homer Soil & Water Conservation District, removes white sweetclover in Seward, one of two species targeted by partners of the Cooperative Weed Management Area for complete eradication from the Kenai Peninsula.*

Sunny, warm days and only a few mosquitos trying to suck my blood lifted my spirits last summer in my uncertain quest to find (and hopefully eradicate) reed canary grass, white sweetclover and bird vetch. Based on some bad experiences in the Lower 48, these three invasive weeds have great potential to do great harm on the Kenai Peninsula.

Within a few decades of mistakenly planting reed canary grass in the Pacific Northwest for soil stabilization and forage, this species spread into wetlands where it disrupted stream flow and devastated salmon

habitat in Oregon and Washington to a point of no return. Bird vetch and white sweetclover were similarly planted for forage, but these Old World species soon out-competed almost every native plant. Vetch can change soil nitrogen and completely replace land cover as its vine-like growth smothers native flora. White sweetclover can alter the landscape as well by changing sedimentation rates in streams with gravel bars.

These threats led me to devote last summer working for the Homer Soil and Water Conservation Dis-

trict, where Matt Steffy coordinates the interagency partners of the Kenai Peninsula Cooperative Weed Management Area (<http://www.kenaiweeds.org>). “It’s pretty unique to have so many different entities working together to accomplish so many interconnected goals” Steffy told me. It is this fellowship that sets the stage for great success in the war on weeds on the Kenai Peninsula.

A major player in the partnership is Chugach National Forest, for they are the frontline of the Kenai Peninsula, seeing invasives first as they spread down the Seward Highway from Anchorage. “We found that most of our invasive plant populations are in areas with human-caused disturbance,” Betty Charnon, a Forest Service ecologist told me. That human footprint is true for the Kenai National Wildlife Refuge as well, where most of our invasives occur along the Swanson, Skilak and Funny River roads. Similarly, Christina Kriedman, an environmental specialist with Kenai Fjords National Park, explains “Herman Leirer Road, the only road in the park, is the primary vector that brings invasive plants into the Exit Glacier area where we spend most of our time controlling invasive plants.”

So, working closely with my sidekick, Kelsey Haas, we traveled miles and miles of Kenai Peninsula Borough and Alaska Department of Transportation right-of-ways last summer. The mission of our two-person strike team was to survey and begin managing infestations of these three species outside of the large federal land management units. Invasives know no boundaries, disrespectful of lines drawn on jurisdictional maps.

We visited 54 sites in Seward that had previously reported infestations of white sweetclover, to which after five years of active management, only 11 sites remain infested. If each site is a battlefield, then we’ve won 80% of the time! Outside of Seward, we found white sweetclover to be practically non-existent on the Kenai Peninsula except around the Portage-Whittier tunnel. This area is especially important as Whittier is the gateway to the pristine Prince William Sound.

We found bird vetch growing in 30 locations that

totalled 50 acres on the Kenai Peninsula. In Homer, vetch occurs only at the corner of Skyline and Katie Jean, and at the Islands and Oceans Visitor Center. Further up the Sterling Highway, we found a patch at Stariski Creek, four infestations in Soldotna, two in the city of Kenai, and one site in Nikiski. With such small point locations, it’s easy to formulate a game plan to eradicate bird vetch from our communities.

Eradication of bird vetch will be trickier in Seward (15 infestations totaling 10 acres) and Portage (21 acres), where relatively large infestations plague the landscape. However, with cooperation and diligence we have a very real chance of eradicating bird vetch completely from the Kenai Peninsula.

Unfortunately, reed canary grass is here to stay. Although it only occurs in 30 of 127 watersheds on the Kenai Peninsula, reed canary grass is too dispersed in those infested streams to seriously entertain the idea of eradicating it. So, using a strategy of containment rather than eradication, we focus on keeping reed canary grass out of the almost 100 watersheds that are pristine by treating connecting right-of-ways and other vectors like airstrips. And when a new infestation takes root, we strike it down and take it out completely before it spreads.

The time to act is NOW. Permits and preparations are already underway to apply herbicide to infestations found last summer. The interagency collaboration is more strategic than ever, allowing us to nip future infestations in the bud faster and more efficiently. With so little of the Kenai Peninsula occupied by bird vetch and white sweetclover, the opportunity is ours to make them go away.

Please contact Matt Steffy (907-235-8177) if you wish to report an infestation that we missed last summer. For more opportunity to contribute to the war on invasive plants, please download the free app “Alaska Weeds ID.”

*Jen Peura is a seasonal biotech at the Kenai National Wildlife Refuge. Find more information at <http://www.fws.gov/refuge/kenai/> or <http://www.facebook.com/kenainationalwildliferefuge>.*



# The tinder fungus, the Ice Man, and amadou

by Matt Bowser



*Amadou cap given to me by Dominique Collet.*

A couple of years ago I was given a remarkable, beautiful hat by my friend Dominique Collet. This cap is made of a soft, brown material with decorative, stamped trim of the same. Light and velvety, it is reminiscent of wool felt but finer and smoother. Dominique had traveled through Eastern Europe specifically to learn how these amadou caps were made from a kind of tree-killing fungus.

Known by several names including hoof fungus, tinder fungus, and the “true” tinder fungus, *Fomes fomentarius* grows on hardwoods, especially birch, around the world in northern latitudes. It is quite common here on the Kenai and anywhere else in Alaska where birch trees grow.

Ecologically, tinder fungus acts both as a pathogen, causing wood rot and contributing to the demise of living trees, and as a decomposer, continuing to break down dead wood in snags and logs. The fungus enters the tree through damaged bark or broken branches, then ramifies through wood and bark. Woody, durable conchs of the tinder fungus appear on the outside of the tree or log and grow larger each year as new layers are added to the underside of the conchs.

By removing, soaking, and pounding the inner, fibrous tissue of the conchs, a material called amadou can be made. This amadou is soft, extremely absorptive, and highly flammable. The abovementioned hat is one example of clothing made from this material.



*Conchs of tinder fungus (*Fomes fomentarius*) on a birch log near Nordic Lake, Kenai National Wildlife Refuge, 17.Feb.2016 (<http://bit.ly/1OsJXAa>).*



*An amadou patch for drying flies (image from <http://www.orvis.com/>).*

Tinder fungus has been used by humans for its namesake purpose for thousands of years. An extraordinarily well-preserved, 5,000-year-old mummy from the Alps known as the Ice Man had on his person in

a little pouch a store of carefully prepared tinder fungus as part of an impressive fire starting kit. Remnants of this fungus have been found in excavations of even older human habitations, where they are believed to have served as tinder and as a way to transport embers in hollowed-out, slowly smoldering conchs.

Amadou's absorptiveness is superlative. Into the 1800s, this material was widely employed by doctors, dentists, and barbers in bandaging, where it earned the name "agaric of the surgeons." To this day, patches of amadou are carried by fly fishermen to dry wetted flies.

Various cultures have taken tinder fungus medicinally as remedies for rheumatism, hemorrhoids, bladder infections, and pain relief. Derivatives of the fungus were imbibed, smoked, and even placed on the skin and ignited. Though some extracts of tinder fungus do show promise as medicinals, I have found no

conclusive studies on its medicinal properties, so it would be wise to hold off on consuming tinder fungus until we know more about it.

Learning about the uses of *Fomes fomentarius* has changed my perspective on this species, moving it from its place in my mind as just another of many wood-rotting fungi to a useful, available resource. I have yet to try my hand at processing tinder fungus, but I think I will soon. I would like to be able to craft a hat similar to the unique amadou cap that was given to me. I might even wear it around, but, given the material's properties, I will not be sporting any amadou clothing anywhere near a campfire!

*Matt Bowser serves as Entomologist at the Kenai National Wildlife Refuge. You can find more information at <http://www.fws.gov/refuge/kenai/> or <http://www.facebook.com/kenainationalwildliferefuge>.*

## Why do bears wake up in winter?

by John Morton



*A brown bear recently emerged from its den makes its way down a steep slope in the Kenai Mountains (credit: National Geographic Society).*

Last week, during yet another winter meltdown on the Kenai Peninsula, I heard three stories about bears on the prowl. There was a guy in Homer who managed to chase off a subadult brown bear with bear spray, reports of several bears roaming Anchorage burbs, and an observation by a refuge colleague on the Alaska Peninsula of a brown bear over a moose kill. So what woke up the bears?

It's easy to surmise that the mild weather had some bearing (no pun intended) on why the bears woke up in mid-February. I can only imagine that the absence of snow as insulation from both cold and external sounds might roust a bear. But I also think the rain was a likely culprit as well.

Years ago, when I was younger and much more foolish, I measured the dimensions of grizzly bear dens high in the Brooks Range. We did it later in the summer, long after the bears had left their dens but, in hindsight, it sure seems that encountering, say, a wolverine in a blind cul-de-sac could have been a bad thing. But I remember that some dens were dry and some were wet. It seemed to me even then that a cold wet drip in a dark hole would wake even the sleepest of bears.

At the end of the day, I couldn't find anything in my quick search of online literature to indicate what actually makes a bear leave its den in the middle of winter, even a relatively warm and mostly snowless



one like we are having now. It may be that each case is unique, and there is no larger pattern. During the winter of 1997-98, brown bears were disturbed at two dens by field workers involved in seismic exploration of leased areas on the Kenai National Wildlife Refuge for underground oil and gas reserves. In a January disturbance, a sow and cub fled their den. In the other disturbance in February, a single brown bear ended up fatally injuring a seismic worker before fleeing the area.

Not to diminish the tragedy, the events do beg the question of how do bears that spend more than half their year in a den spring to life at the drop of a hat? Consider that Astronaut Scott Kelly, who just returned from nearly a year in space, needed help getting out of his space capsule and will likely have brittle bones, weak muscles and a smaller heart. While admittedly in zero gravity, he was also active and exercised during a period that translates to 1/70<sup>th</sup> of his expected 70-something-year lifespan. A bear not only spends about 1/70<sup>th</sup> of its 35-year lifespan mostly sleeping in a small capsule-like den in any given year, it does this EVERY year, and yet it still manages to not lose muscle tone or bone calcium.

Researchers from the University of Alaska Fairbanks published an interesting study in the journal *Science* in 2011 on what happens to a bear's vital signs during hibernation. They found that despite lowering their metabolism by 75% and its heart rate from 55 to as few as 9 beats per minute, black bears maintained their body temperature within a few degrees of normal

(90 degrees). As an aside, at least one of their study subjects was a black bear from the Kenai Peninsula.

And despite not eating, drinking, urinating or defecating for five to seven months of the year, they don't lose mineral content or muscle mass, producing water and up to 4,000 calories per day from the breakdown of body fat. Dr. Brian Barnes, a coauthor of this study, commented that "they're a closed system—all they need is air, and they can do just fine."

The muscle and organ tissues of bears also breakdown to supply amino acids and proteins. We do the same thing when we're starving except that our bodies don't restore muscle and organ tissue. Bears are somehow able to recycle the nitrogen in urea to build new protein while not allowing it to become toxic as it does in humans.

While bear biology is remarkable, none of this explains why bears wake up in the middle of winter. However, the UAF study found that after emerging from dens, bears maintained their reduced metabolic rates for up to three weeks even as their temperatures returned quickly to normal. My take on this is that a bear encountered in mid-winter in Alaska is probably not hungry. But don't bet on my opinion—avoid fresh bear tracks in snow, or carry bear spray if you insist on walking or skiing in their tracks.

*Dr. John Morton is the supervisory biologist at Kenai National Wildlife Refuge. Find more information at <http://www.fws.gov/refuge/kenai/> or <http://www.facebook.com/kenainationalwildliferefuge>.*

# How prior fuel treatments helped manage the 2015 Card Street Fire

by Nate Perrine



*The 2015 Card Street Fire was controlled on portions of the north and east flanks because of a change in forest characteristics created by two different fuel treatments conducted in 1984 (white lines) and 2009 (black lines).*

On June 17<sup>th</sup>, 2015 the Card Street Fire, fueled by strong westerly winds and very hot and dry conditions, became extremely active and made a significant push to the north and east. It was a continuous line of fire burning in the tops of trees, with flames in excess of 100 feet long. Embers being lofted into the air by the tremendous convection column created by these extremely hot conditions can potentially land up to two miles in front of the flaming front and start new fires.

With these conditions, there is nothing that firefighters can do to stop it. It is a runaway freight train. The only options available are to play defense by protecting structures out in front of the fire, and waiting for either the forest characteristics or weather conditions to change to bring the fire back down to a level where firefighters can re-engage in fighting it.

The news is not all bad, though. Way back in 1984, when the new movie *Gremlins* was making its rounds in local theatres, the Kenai National Wildlife Refuge conducted a “fuels treatment” in what has since been renamed the Skilak Wildlife Recreation Area. Huge machines called LeTourneau tree crushers were deployed to masticate about 600 acres of dense spruce forest and create openings in order to improve the overall habitat for moose. In 2009, using more modest equipment, another 100 acres was cleared of spruce in the same area, this time for the purpose of creating a site for wildlife viewing.

Fast forward over 30 years and it turns out these treatment areas influenced how and where firefighters were able to contain the Card Street fire. By removing the old spruce-dominated tree cover, new “pi-

ioneer” species of trees and brush quickly shot up with birch, aspen, poplar, and willow being the most common.

Although not a direct replacement for natural fire, in a way these treatments mimic what would occur after a forest fire. Spruce forests burn with varying intensities, and typically some areas are completely scorched while others experience less severe effects. The first vegetation to come up to replace the dead spruce in the scorched areas after a fire are these pioneer species. Leafy, deciduous trees and shrubs are associated with much less intense potential fire behavior than the spruce forests.

The Skilak fuel treatments provided one of the two conditions necessary to help subdue the Card Street Fire. These treatments changed the forest from primarily spruce to a mix of the leafy pioneer species. The fire marched to the north and east until it hit the Skilak Loop Road.

On the other side of the road, due to the fuels treatments, there was no longer a continuous canopy cover of spruce for the fire to consume. Instead, the fire dropped down from the tree canopy and remained on the surface. Flame lengths of 100 feet plus were now between 2–5 feet tall. Embers were no longer able

to be launched miles ahead to start new fires. Firefighters took advantage of the change and were able to contain the north and east portions of the Card Street fire in these areas. Had the treatments not occurred, it is very likely that the fire would have continued to burn under extreme conditions through the continuous canopy cover of spruce that would have been present.

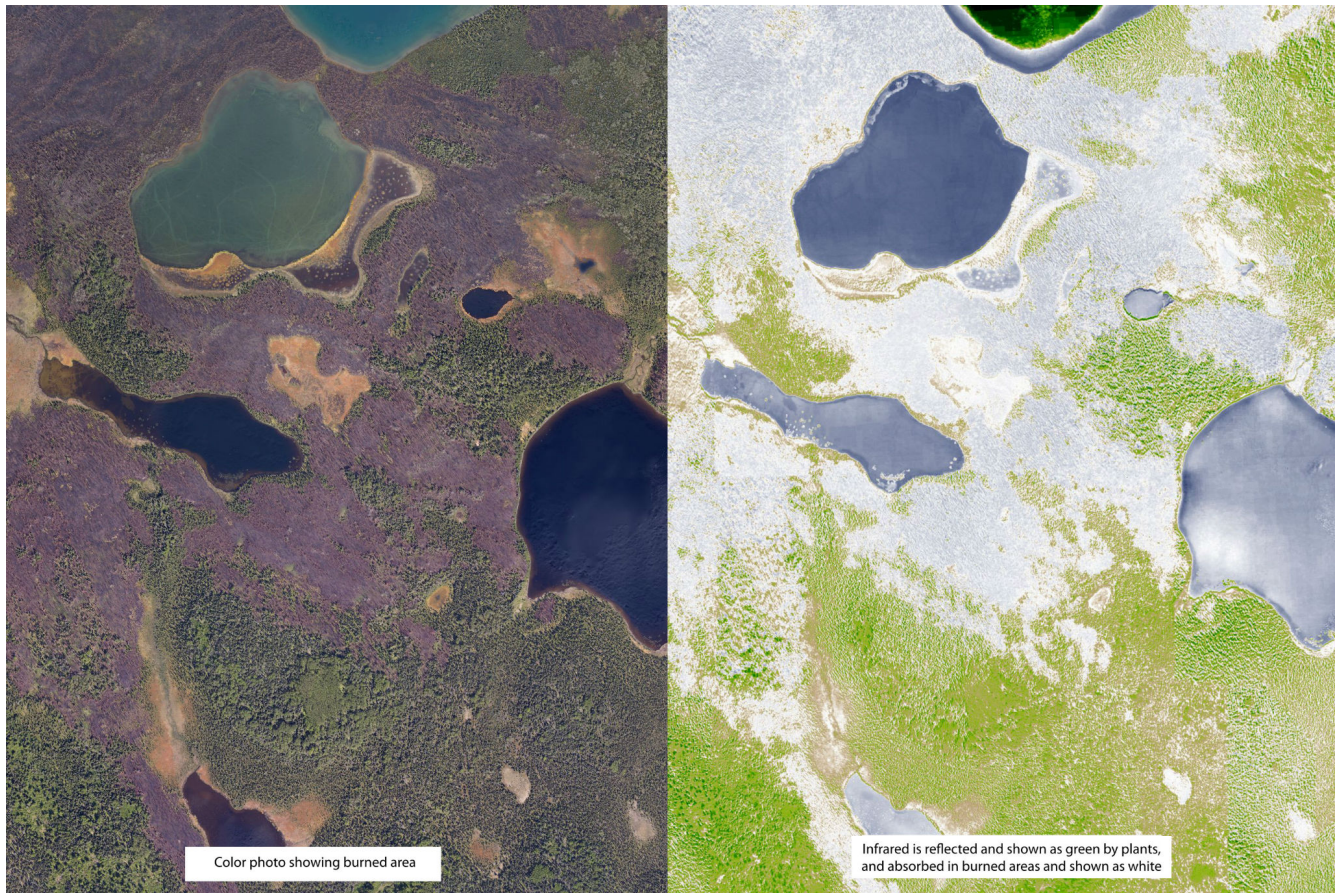
Both natural and man-made disturbances can be effective at maintaining healthy ecosystems. In coordination with our partners on the Peninsula, the Refuge continues to plan and implement both mechanical and prescribed fire treatments for the purpose of reducing fuel loads in strategic areas of the wildland-urban interface. Although resource management by humans is far from perfect, here on the Kenai Peninsula we believe that using several approaches to mimic natural disturbances at strategic places is the best option for attempting to balance the often conflicting needs of humans with ecosystem health.

*Nathan Perrine is the Fire Operations and Prescribed Fire Technician at the Kenai National Wildlife Refuge. You can find more information at <http://www.fws.gov/refuge/kenai/> or <http://www.facebook.com/kenainationalwildliferefuge>.*



## Structure from Motion: new technology to answer landscape-scale questions

by Mark Laker



*Vegetation response to the 2014 Funny River Fire can be inexpensively and accurately monitored using aerial infrared photography taken from a fixed-wing aircraft.*

When Alaskans travel, we commonly run into people we know in far-away obscure places. Instead of running into someone I knew during a recent trip, I met someone sharing what I consider obscure knowledge.

Last spring I was on a flight to Fairbanks to learn about a new remote-sensing camera being operated by the University of Alaska Fairbanks (UAF). Remote sensing is simply a means of gathering information about something without touching it. Typically this involves a sensor on an aircraft or satellite to observe phenomena on earth.

I have a hard time sleeping on planes, so I was reading a paper comparing the accuracy of earth surface models created by aerial laser scanners (LiDAR) and traditional photogrammetry techniques. Photogrammetry is the science of making measurements from photographs. I had been working on several aerial photography projects that incorporated traditional photogrammetry with computer vision to create accurate three-dimensional surface models along with high resolution image mosaics.

I was finally starting to yawn when the guy next to me commented, “I see you’re doing some science.” It

took me a moment to snap back to consciousness and I did my best to explain in simple terminology what I was doing. The gentleman responded with a slight English accent, “Oh, you’re doing Structure from Motion”. Until then, I knew only two people who were familiar with that term (SfM), which was **PRECISELY** what I was doing.

He then asked if that was why I was going to Fairbanks. At this point I should have stopped talking, and let the gentlemen introduce himself. Did I stop? Of course not—instead I gave my laymen’s explanation of the new remote sensing camera at UAF. I was struggling to remember the name of the professor in charge of the program, when the gentleman politely responded, “Oh, you’re talking about Dr. Anupma Prakash of the Geophysical Institute and the hyper-spectral camera.” My fellow passenger turned out to be Steve Masterman, Director of the Alaska Division of Geological and Geophysical Surveys (ADGGS), whose staff was coincidentally also doing the same “obscure” photogrammetry work that I was doing.

Photogrammetry allows us to make precise measurements from photography such as distance between two points, height of a building or tree, or area of a forest. The fundamental principle in photogrammetry is triangulation, the same process that allows you to perceive depth or distance with your eyes. As you focus on an object, imagine lines coming from each eye and converging on the object. The distance between your eyes is called the baseline. By determining each angle of the converging lines, your brain has triangulated on that object.

Now let’s take two overlapping images. The distance between the camera shots is now the baseline. By identifying the same object in each photo, the photo can be aligned and the angle of the converging lines from the cameras to the object can be calculated. This was the basic process used by photogrammetrists until computer vision came along.

Now, instead of humans identifying objects in overlapping photos, computers do, using software that can identify tens of thousands of matching points in a pair of photos. From this, it can calculate the three-dimensional position of the pixels in the photos. This is the “structure” in SfM. The “motion” comes from moving the camera to gain at least two perspectives needed for the triangulation. Most of our projects con-

tain a couple thousand overlapping photos.

Since last spring, my network of SfM colleagues has grown along with our questions. Though our collective efforts were paying off, emails and phone calls only get you so far. So we decided to gather folks doing similar work across Alaska to share our work and expertise, culminating last week with an Aerial Photography and SfM workshop, hosted at the Kenai National Wildlife Refuge’s Visitor Center. The main goal of the workshop was to share our cumulative knowledge to improve the quality and consistency of the data we collect.

Dr. Gabriel Wolken (ADGGS) presented on how the State is using this technology to monitor hazards around Alaska, including shoreline change and coastal vulnerability, snow avalanche susceptibility, glacier related flood hazards, landslides, and debris flows. Scott Arko (Alaska Satellite Facility), has been creating orthomosaics and digital surface models from historic aerial photos, allowing us to evaluate landscape changes dating back to the 1940’s and 1950’s. Seth Kiester (Bureau of Land Management) used a modified infrared camera to illuminate tundra lichen in aerial photos as a relatively rapid way for assessing caribou habitat. Nathan Pamperin (Alaska Department of Fish & Game) has photographed herds of migrating caribou to estimate their population.

As part of assessing the 2014 Funny River Fire, I also used an aerial infrared camera to measure plant health. Plants reflect infrared light when they are healthy and growing (see photo). The Refuge will be using aerial photography and SfM this summer to plan and monitor wildfire fuel breaks.

The presentations revealed how the technology has allowed for landscape-scale monitoring that would have been cost prohibitive using traditional manual-intensive techniques. We made great progress in our goal to improve the quality and consistency of the data we collect through sharing our collective experiences. Of course, many new questions and challenges were brought to light, only to be solved by ongoing and future collaborations in applying SfM.

*Mark Laker is an ecologist and database manager at Kenai National Wildlife Refuge. Find more information at <http://www.fws.gov/refuge/kenai/> or <http://www.facebook.com/kenainationalwildliferefuge>.*



## Agencies work together to study Kenai moose

by Nate Olson



*One of 30 cow moose recently captured and collared in Game Management Unit 15A and 15B in a joint effort by the Alaska Department of Fish & Game and Kenai National Wildlife Refuge. (Photo credit: Dan Thompson, ADF&G)*

Moose continue to be one of the most valuable species that reside on the Kenai Peninsula. They trigger an emotional response from most folk and can consistently be viewed by residents and visitors at any time of the year. Highly prized by hunters and wildlife watchers, feared by motorists, and often despised by gardeners, moose have sparked enormous interest by wildlife managers and researchers over the years.

For the past several decades, the tool of choice for moose researchers in Alaska has been radio-collars and, in recent years, GPS collars. These devices allow

researchers to pinpoint an individual moose's location at just about any time and allow for the in-depth analysis of moose movement through time. There are many challenges related to affixing a collar around the neck of a gigantic wild animal. One can't simply walk up to a wild moose and strap a collar on it without potentially serious repercussions. Our solution is to use helicopters.

Capturing a moose from the air is a well-coordinated event that can be loosely compared to a well-choreographed episode of "Dancing with the

Stars”. Several skilled biologists and pilots are needed to pull it off and the resulting sequence of events is graceful to watch. Once the target moose is identified from a spotter plane, a helicopter swoops in so a biologist can dart the animal with an immobilizing chemical cocktail that will eventually sedate the animal. The spotter plane circles overhead to monitor the drug’s effects and ensures the moose avoids any potentially deadly situations such as creeks or lakes.

Once the drugs take effect and the animal is immobilized, the helicopter returns with a team of biologists to “process” the animal. Typically this involves fitting a radio-collar, taking measurements, and collecting blood or fecal samples. An antagonist or “reversal” drug is then administered which counteracts the effects of the immobilizing drugs and the moose is sent on her merry way. Then it is on to the next subject.

During this past month, the Kenai National Wildlife Refuge, in cooperation with the Alaska Department of Fish and Game, successfully captured 30 moose using these methods in Game Management Units 15A and 15B. The goals of the two agencies were the same, to capture a specified number of moose and fit them with GPS collars, but how we will use the data differs.

ADF&G will use the GPS data in two ongoing moose studies. The purpose of the first study is to collect and analyze baseline data on seasonal body condition, productivity, and movements of moose in response to intensive management in GMU 15A. The purpose of the second ADF&G study is to evaluate how moose respond, both physiologically and behaviorally, to daily and seasonal fluctuations in environmental temperatures. Biologists will evaluate how wild moose select habitat based on thermoregulatory costs in different successional stages of the boreal forest, one in recently-burned areas and the other in mid-to late-seral stages. These data will ultimately allow

managers to identify areas that can provide both thermal relief and adequate forage for moose during seasonally warm temperatures when planning habitat improvements for these populations.

At the Kenai Refuge, we’ve grown increasingly interested in recent years about how moose may be using residential areas on the central peninsula. We all see moose feeding along our roads during winter and calving in our neighborhoods in the spring. Much like moose in Anchorage, there is anecdotal evidence that some moose may spend most if not all of their life cycle within urban areas. On the other hand, we know that some moose may use residential areas as relatively safe places to spend their winters or drop their calves, but only seasonally, choosing to spend most of their life cycle on the Refuge. So we will use the GPS collar data to assess moose behavior, movement, and habitat use along the urban interface.

In addition, several moose were collared close to the Sterling Highway, east of Sterling, within the Refuge. We are interested in assessing moose movements in advance of road improvements that are scheduled to begin this summer on the 22-mile section of the highway that runs from Sterling to Jim’s Landing (MP 58-79). Collecting pre-construction data will allow us to better evaluate the post-construction success of culverts, fencing and a bridge being built to guide and facilitate wildlife crossing the Sterling Highway.

The collaborative nature of this study allows Federal and State biologists to reduce the costs of research while sharing data. And just maybe the bright orange collars hanging around the necks of some Kenai moose will make them a bit more visible and prevent a vehicle collision or two.

*Nathan Olson is the wildlife biologist-pilot at Kenai National Wildlife Refuge. Find more about the Refuge at <http://kenai.fws.gov> or <http://www.facebook.com/kenainationalwildliferefuge>.*



# You never know who will walk through the door

by Candace Ward



*A younger Jerry Deppa builds Finger Lakes Cabin on Kenai National Wildlife Refuge in 1965—over 50 years ago.*

You never know who will walk through the door at the Kenai National Wildlife Refuge Visitor Center. I had the pleasure in late January of meeting Jerry Deppa, who came from his home in Sitka to visit friends on the Kenai Peninsula and renew his connection with the Refuge after being away for 50 years.

He wanted to take a hike to visit the Finger Lakes Cabin in the Refuge. I had to sadly tell him that it had burned down in 2003. He proceeded to tell me that he had built the cabin in 1965—51 years ago! He shared how he had cut 50 spruce trees in a small upland bowl on the east side of the Finger Lakes with hand saw and ax. He skidded the trees manually to the cabin site and built the cabin with a black spruce pole and sod roof. The cabin was a research site for field studies on spruce grouse with ADF&G Biologist Larry Ellison. Findings from the study were incorporated into the Alaska Department of Fish & Game Wildlife Notebook Series which can be found to this day at the following website—[http://www.adfg.alaska.](http://www.adfg.alaska.gov/index.cfm?adfg=educators.notebookseries)

[gov/index.cfm?adfg=educators.notebookseries.](http://www.adfg.alaska.gov/index.cfm?adfg=educators.notebookseries)

As we continued to talk he also shared his Dall sheep hunting adventures in the Caribou Hills and Tustumena Glacier country. His most amazing story is a horse pack trip in the fall of 1966 with his saddle horse Jigs and pack horse Dora Day. He started out following the survey tape flagging of the “new” Funny River Horse Trail pioneered by then Refuge Manager, Will Troyer. Much of the trail was through boggy country and without Jigs, who moved like an acrobat stepping carefully on the tops of sphagnum moss hummocks, he never would have made it to the uplands of Caribou Hills.

He set up his base camp in the rain at the edge of fresh snow blanketing the steep rocky slopes, so he had pasture available for his horses. Each day he headed up to higher country in search of Dall sheep rams. He and the horses worked their way into the peaks and he often spotted bands of rams far off in the distance. With much of the high country covered in

low, dense clouds and frequently snowing, white-out conditions made getting close to the rams impossible.

On one of his hunting days he stayed out too late and, caught out in steep terrain with failing light and blowing snow, he had to rely on Jigs to find the route back to camp maneuvering narrow sheep trails in the dark. In fact, Jigs amazingly made a dead stop right next to Jerry's wet tent not even tripping on the guy lines in the complete darkness. Jerry said "you could always rely on Jigs to get you home."

Talking to Jerry in more depth, he shared that professionally he is a locksmith and for fun he is a volunteer for Friends of Alaska National Wildlife Refuges on St. Lazaria Island west of Sitka. For the last four years he has helped to support the seabird research operations of the Alaska Maritime National Wildlife Refuge. In fact, it turned out that my good friend and retired colleague, Poppy Benson, had worked with him on St. Lazaria.

He did go for a hike out to the Finger Lakes cabin site to show his friend, Amanda Millay. He just happened to run into retired Refuge Ranger Gary Titus on the trail. They were able to share stories about the

Refuge and Finger Lakes Cabin. I am always surprised that in the vastness of Alaska and the Kenai Peninsula, you often connect with people who know people that you know—it's a small place in that regard.

I definitely was inspired by Jerry's love of the outdoors and wildlife, adventurous spirit and lifelong connection to wildlife research. I also thought it was wonderful for him to return to the Kenai after half a century to revisit his special places.

Do you have a special story or remembrance to share about how the Refuge has affected your life? We are gathering Refuge stories in honor of the Refuge's 75<sup>th</sup> Birthday and hope to share them in a variety of ways—in articles like this one, at live events, on our website and through Facebook. Please get in touch with me and share your story.

*Candace Ward is a park ranger who has worked in the Refuge's Visitor Services Program for over 30 years. If you would like to share a special Refuge adventure story, please contact her at 907-260-2807 or e-mail at [candace\\_ward@fws.gov](mailto:candace_ward@fws.gov). Find more about the Refuge at <http://kenai.fws.gov> or <http://www.facebook.com/kenainationalwildliferefuge>.*



*Jerry Deppa, now a Friend of Alaska National Wildlife Refuges, volunteers his time helping with research on St. Lazaria Island in Alaska Maritime National Wildlife Refuge.*



## Kenai Refuge cabins: solitude with a bit of comfort

by Dan Saxton



*Doroshin Bay Cabin, a restored cabin built on Skilak Lake shortly after WWII, is available for reservation.*

Before I landed my dream job here with the Kenai National Wildlife Refuge Cabin Program, my wife and I had standing New Year's Eve plans—spend a few nights in a yurt or cabin in one of Colorado's state parks. The plan was simple—invite a bunch of friends and try to convince those who were more “indoorsy” that, yes, the yurt would be plenty warm and that, no, the outhouses weren't bad at all. We'd ring in the New Year well out of cell service range, playing all sorts of card and board games that we never play at home while sneaking outside for some late-night sledding sessions. To be sure, it wasn't all ‘Kumbaya’ around the fire, but even the mishaps, and there were plenty of those, were all part of the experience.

For example, the first year I had to break trail after a blizzard dumped over six feet of fresh snow. Another year I found myself running up the trail to get to the cabin and start a fire to warm up a ten-month old baby on his first camping trip. And there's the time we crammed the woodstove full just before bed and woke up to an inferno, a total sweat lodge that sent us scrambling for the door and the sweet relief of the

freezing cold air. The stories and memories from these trips will stay with me for the rest of my days. Not bad for a kid from New York whose parents considered a hotel room with no a/c and only basic cable to be seriously roughing it.

I have these simple structures in the middle of the forest to thank for all these great times. They gave us a destination and a sense of security that a tent can only dream of. It didn't take long for me to go from appreciating those trips, to looking forward to them all year, to missing them terribly. Luckily for me (and you), the public cabins on the Kenai National Wildlife Refuge offer the same opportunities to connect—not just with nature, but with our friends and family as well.

The Kenai Refuge Cabin Program began in 2005 with the restoration of several cabins that preserved fine examples of striking craftsmanship. Today the Refuge maintains 16 cabins, including nine historic structures, which are spread throughout the refuge—Tustumena Lake, Skilak Lake, and elsewhere on the western Kenai Peninsula. Access to the cabins varies

from a short wheel-chair-accessible walk to longer boat or fly-in only access.

Each cabin is outfitted with just a bare minimum of creature comforts—sleeping bunks, a wood stove, indoor and outdoor picnic tables, a fire pit, and a cabin notebook where you can share a story or two. Some of the lakefront cabins include row boats as well. You'll want to bring your own dry kindling and probably firewood as well. Firewood can be cut from dead and down trees (bow saws and splitting mauls are provided), but is scarce at the more popular locations. The cost of the cabins is \$35 to \$45 per night plus a booking fee and most require an advanced reservation (but Emma Lake and Trapper Joe cabins are first come/first served).

The Kenai National Wildlife Refuge is proud of our cabins and is thrilled that they are loved and well taken care of by the public. To make reservations for any of the reservable cabins log on to <http://1.usa.gov/tsavSb>. For specific questions about the cabins, please call the Kenai National Wildlife Refuge at 907.262.7021. Meanwhile I'm planning on reinstating our New Year's Eve tradition here on the Kenai Refuge. Who knows—maybe one day I'll even be able to convince my parents to spend a night or two?

*Daniel Saxton is on the cabin crew at the Kenai National Wildlife Refuge. Find more information at <http://kenai.fws.gov> or <http://www.facebook.com/kenainationalwildliferefuge>.*



*Dan Saxton chopping firewood at a yurt in Colorado prior to joining the cabin crew at Kenai National Wildlife Refuge.*



# Warm winters and other signs of the Anthropocene

by John Morton

C-10 Peninsula Clarion, Sunday, June 19, 2011



Humans Causing Fast Changes

## Earth in Sixth Major Extinction

As most kids probably know, dinosaurs came to a sudden end about 65 million years ago. Did you know that there have been four other super-big, or **mass**, extinctions of life on Earth?

Most scientists believe we are in the middle of a sixth mass extinction. But this time, the extinction isn't being caused by an asteroid or volcanoes. Its causes can be traced to us.

To find out more about this event, The Mini Page talked with Michael Brett-Surman from the Smithsonian National Museum of Natural History.

### What is a mass extinction?

When a **species**, or type of life, becomes **extinct**, it means there are no more members of that species alive.

Extinctions are normal. Usually, there is a steady rate of extinctions during every million years. Life-forms naturally appear and disappear over time.

In a **mass extinction**, at least one-fourth of all plants and animals on the planet might be wiped out very quickly, much faster than normal. Huge numbers of species die, and no new species appear in that time.

Scientists are seeing this happen now on Earth.



The most famous mass extinction was at the end of the Cretaceous Period, when six out of seven of all dinosaur groups were wiped out, along with half of all life. There is evidence that a giant asteroid hit the Earth then.

### Climate change

Each time there has been a mass extinction, it was because something caused the climate to change. Many types of life could not **adapt**, or change, quickly enough, and they died.

During the current mass extinction, humans will be able to adapt, but our crops and animals might not. Life as we know it will keep changing.

### The ages of Earth

Each time there is a mass extinction, a new age begins on Earth. As older species die out, other species suddenly have no competition. They begin to fill in the Earth's habitats.

Over millions of years, newer types of life develop. Diversity increases again. The makeup of the planet changes yet again.

Let's explore Earth's earlier mass extinctions.

### End of the Ordovician

The Ordovician (or-doh-VIH-shun) Period ended about 445 million years ago. Most life lived in the oceans at this time. Experts believe more than 50 percent of life was wiped out at the end of this age.

One reason for the extinctions might have been a drop in sea level. Huge glaciers might have formed, locking up much of the planet's water. This would have caused sea levels to drop. Life in shallower waters might not have been able to adapt quickly enough to survive.



*Five years ago (2011) when most adult Americans were just starting to have serious conversations about whether or not climate change was real, our kids were learning about the Anthropocene in the Peninsula Clarion's Sunday comics.*

Most Alaskans would likely agree that this has been a winter of very strange weather with very strange outcomes. Winter 2015 was the warmest the U.S. has experienced since records began in 1895—Alaska was almost 11 degrees warmer than normal! The first wildfire of 2016 near Delta was strange on two counts: it started in tundra and it started in late February. During the first week of our rainy January, a local resident sent me a photo of a gentian blooming in her rock garden above the Kenai River! And now Margie Mullen, one of our original and still very spry homesteaders, says this is the first winter since 1947 that the Kenai River near Soldotna Creek hasn't frozen over.

These are startling statistics and observations about a winter gone awry. Most think these are signs

of a warming climate, but many still think it's just unusual weather. A survey of 750 Alaskans in January 2016 by Ivan Moore Research showed that 54 percent of Alaskans believe climate change is happening while 21 percent believe it will happen in the future. That still leaves 1 in 5 Alaskans believing that climate change will have negligible impacts. And while slightly more than half of Alaskans believe climate change is caused mostly by humans, 38 percent also believe it's due to natural variation and 7 percent believe it simply doesn't exist.

I can accept that there are varying levels of understanding among Alaska's diverse public, but here's what's really weird to me. According to the Yale Program on Climate Change Communication, only 37 percent of Alaskans (in 2014) think that most scientists

think that climate change is happening.

And that couldn't be farther from the truth. The most recent update by the Intergovernmental Panel on Climate Change, comprised of more than 830 international scientists, concluded that warming of the atmosphere and ocean system is unequivocal, and there is a clear human influence on the climate. More than 97 percent of actively-publishing climate scientists agree that climate warming trends over the past century are extremely likely due to human activities.



*An ornamental variety of gentian that bloomed in early January 2016 among ice crystals in a rock garden on the bluffs above the Kenai River (credit: Kathy Wartinbee).*

So why do so many reasonable people doubt science? An article published in *National Geographic* this month asks that question. The author, Joel Achenbach, raises a lot of interesting points, but two caught my attention. Most of us walk around (frequently unwittingly) with “naïve beliefs” about the way the world works that were likely shaped by our upbringings and the cartoons we watched as kids (my words). Even as we educate ourselves, these beliefs haunt us, waiting for an anecdotal observation or spurious event to confirm these beliefs to ourselves despite overwhelming science and data to the contrary, a behavioral phenomenon called “confirmation bias”. So, if you are one of those who believe that humans couldn't possibly have changed global climate (it's global for goodness sake!), you just need to read about the less than 3 percent of climate scientists for whom climate warming is a hoax to feel vindicated.

I see three great uncertainties in discussions about contemporary climate change, only two of which are regularly discussed in public forums and which were

introduced again in this article: Is climate change real? And is it caused by humans? The third one that gets routinely overlooked not just among the public, but among agency and academic professionals who are engaged in developing adaptation approaches to climate change, is how bad is it really going to be? There's bad and then there's really, really bad. After all, a snowless winter in 2015 isn't the end of the world nor do ducks returning early this spring to Kenai Flats constitute an imminent threat. But salmon spawning in non-glacial waters that reach lethal temperatures in July is another thing.

And on the far end of the badness scale is the Anthropocene, a term made infamous by Dr. Paul Crutzen, who won a Nobel Prize in Chemistry. The Anthropocene was suggested as a term to describe the geologic time we are in now and probably have been in since at least the beginning of the industrial age (mid 1800s), a period coinciding with contemporary climate change. Sometime this year, the International Commission on Stratigraphy is expected to decide whether the Anthropocene is a true geologic epoch, a decision that leaves no doubt about what causes contemporary climate change.

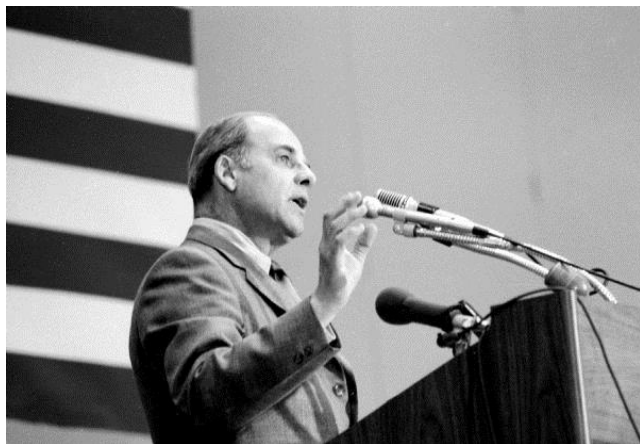
What makes the Anthropocene so “bad” is that it explicitly assumes that mass species extinction is the outcome of contemporary climate change. Starting 450 million years ago, radical disruptions in earth's climate caused extinctions of 50% or more of species at the close of five periods now called Ordovician, Devonian, Permian, Triassic and Cretaceous. The Anthropocene is viewed as the beginning of the world's sixth extinction, a notion popularized in a 2014 book by Elizabeth Kolbert.

So, be open to the idea that while science doesn't have it all figured out, climate scientists are genuinely and increasingly concerned about the velocity of climate change. You don't have to believe that the world is barreling towards mass extinction, but there are no solutions until a problem is recognized as a problem. Think of it this way. If scientists are wrong about climate change, then we've wasted some time and money trying to make our world a little more sustainable. But if scientists are right about climate change and the Anthropocene is upon us, we're at the beginning of a long and rough ride.

*Dr. John Morton is the supervisory biologist at Kenai National Wildlife Refuge. Find more information at <http://www.fws.gov/refuge/kenai/> or <http://www.facebook.com/kenainationalwildliferefuge>.*

# The story behind Earth Day

by John Morton



*U.S. Senator Gaylord Nelson, founder of Earth Day, speaking on April 22, 1970 in Denver, Colorado (credit: Wisconsin Historical Society).*

Today is Earth Day! It's celebrated every April 22<sup>nd</sup>, the first time in 1970 by 20 million Americans. When Earth Day went global in 1990, 200 million people from 141 countries celebrated. Now, in 2016, 193 countries will participate, their efforts coordinated by the Earth Day Network (<http://www.earthday.org/>).

On the face of it, Earth Day is exactly what it appears to be—global appreciation for the planet we live on—expressed as planting trees, picking up roadside litter, biking to work, an electronic recycling drive, restoring a beach dune, or the signing by more than 120 countries of the Paris Agreement on climate change that begins today. Here on the Kenai, there will be a drum circle, guided meditation and a potluck at “Where It's At”, and a concert at Kenai Central High School. Outreach staff from the Kenai National Wildlife Refuge are conducting a special program in local schools today.

But like most things in Life, there is a story behind the story. It's one of perseverance and passion by Gaylord Nelson, the founder of Earth Day. As the “Conservation Governor” of Wisconsin from 1959-1963, Nelson left a legacy of state programs that has served the Cheese State well. He was elected to the U.S. Senate in 1963, hoping to make his conservation agenda a national one.

Senator Nelson found out early on that a fresh-

man senator does not have the clout of a governor when it comes to making changes. Leading up to Earth Day, Nelson was both appalled at environmental catastrophes he witnessed in the 1960s and the focus of Congress at the time on everything other than the environment. 1962 was the year Rachel Carson published *Silent Spring*, highlighting the dangers of indiscriminant pesticide use, particularly DDT. 1964 drew attention to rapidly disappearing wild lands in the U.S. with passage of the Wilderness Act. 1965 was when Lady Bird Johnson's efforts to beautify America helped pass federal legislation that regulated billboards and junkyards along highways. 1968 saw publication of *The Population Bomb*, Paul Ehrlich's book that made zero population growth a buzz acronym (ZPG) and reportedly inspired Nelson.

But it was Senator Nelson's visit to the 1969 Santa Barbara oil spill in southern California, still the third largest oil catastrophe in the U.S. after the 1989 Exxon Valdez and 2010 Deepwater Horizon spills, that made him realize he not only had to do something, he had to do it in an unconventional way for Congress to pay attention.

Inspired by the grass-roots student movement against the Vietnam War, Nelson proposed a “national teach-in on the environment” to the national media, persuaded Congressman Pete McCloskey to serve as his co-chair, and enlisted Denis Hayes from Harvard as national coordinator. Hayes recruited a national staff of 85 to promote events across the U.S., deliberately picking April 22 because it fell between spring break and final exams for college students.

Long before the internet and social networking, Earth Day 1970 successfully brought 20 million Americans to the streets, parks, and auditoriums to demonstrate for a healthy, sustainable environment in massive coast-to-coast rallies. Ten thousand schools, two thousand colleges and one thousand communities participated—Congress even shut its doors so lawmakers could participate in local events!

“There was so much interest at the local level all over the country that we saw we wouldn't have needed to do anything other than to make the announcement and name the day” (Nelson in 1970).

Considered a watershed moment in the environmental movement, Earth Day 1970 achieved a rare political alignment, enlisting support from Republicans and Democrats, rich and poor, urbanites and farmers, tycoons and labor leaders. It ushered in the “Environmental Decade” of the 1970s, leading to creation of the U.S. Environmental Protection Agency and passage of the Clean Air, Clean Water, and Endangered Species Acts. Nelson co-sponsored laws that preserved the Appalachian Trail, established fuel efficiency standards in automobiles, controlled damage from strip mining, and led to banning DDT and Agent Orange.

After Nelson lost his fourth bid as a U.S. Senator in 1980, he remained in national environmental politics as a counselor with The Wilderness Society until his

death in 2005. For his role as Earth Day founder, Nelson was awarded the Presidential Medal of Freedom, the nation’s highest civilian honor, in 1995.

As a footnote to this story, although I’ve never met Senator Nelson, my family rented a house for a brief time from his sister, Janet, when we moved from Hawaii to Wisconsin in 1969, the year before the first Earth Day. Married to Karl Lee, once the Mayor of Peiping (Beijing), they had fled China as Mao Tse-tung took power in the late 1940s. Clearly another story behind the story.

Happy Earth Day!

*Dr. John Morton is the supervisory biologist at Kenai National Wildlife Refuge. Find more information at <http://www.fws.gov/refuge/kenai/> or <http://www.facebook.com/kenainationalwildliferefuge>.*



## Wonderful vernal pool life

by Matt Bowser



*Water scavenger beetle in a vernal pool near the Kenai National Wildlife Refuge Visitor Center on Ski Hill Road, April 26, 2016. Credit: Matt Bowser/USFWS. Observation record: <http://bit.ly/1XWnDWt>.*

As a child I could often be found poking around in water bodies of any size fascinated by the myriad of strange invertebrates frantically going about their brief lives. The small field guide, *A Golden Guide: Pond Life*, with its simple illustrations and brief accounts of amazingly diverse living things, inspired me to go out and see what I could find. I still enjoy doing this.

In our area, now is the time to visit snowmelt pools, also known as vernal pools, depressions that temporarily fill with water in the spring and then dry up in the summer. The absence of all fish—even the seemingly ubiquitous sticklebacks—means that invertebrates dominate these little systems.

Vernal pool communities can be amazingly busy and diverse including mosquito larvae, caddisflies, midge larvae, water beetles, water striders, water boatmen, small crustaceans, fishing spiders, worms, seed clams, and other things. At times I have seen pools rippling with so many invertebrates that the whole water body seemed to be moving, the perception of movement and life being obvious even at some distance.

Many insects can inhabit these temporary pools on a temporary basis. Diving beetles, usually the top predators of vernal pools, can overwinter in permanent ponds, then fly long distances in the spring looking for suitable water bodies. As these dry up, the beetles can again take to their wings in search of wetter homes.

Diving beetles appear to have difficulty distinguishing between water and artificial dark objects like car windshields and especially trampolines, closing their wings in mid-air and diving in. I think every kid who has spent much time on a trampoline in the summer around here can attest to this phenomenon.



*Vernal pool near the Kenai National Wildlife Refuge Visitor Center on Ski Hill Road, April 26, 2016. Credit: Matt Bowser/USFWS.*

The most abundant species of mosquitoes in vernal pools survive the winter as eggs. When these are immersed in melt water the eggs hatch and the larvae begin feeding and growing, often while there is still snow on the ground. By May the adults emerge and are among our most numerous and annoying mosquitoes in May–June. Successful females, after having fed on their preferred mammalian blood and gestating, will seek dried-out vernal pools where they will deposit their eggs.

Fairy shrimp, my personal favorite inhabitants of snowmelt pools, look to me like creatures that belong

in the plankton of the Antarctic Ocean. There is something mesmerizing about the way they swim slowly upside-down through the water with rhythmic beating of their many appendages.

Fairy shrimp specialize in temporary pools where they feed mostly on algae. Pools I checked this week contained immature fairy shrimp. They should be maturing in the next week or two, producing durable, encysted eggs, then disappearing until next spring. The eggs actually hatch within the cysts over the winter so that the young shrimp will be ready to emerge quickly as soon as the ponds fill with water.

These durable fairy shrimp eggs also serve as a way for the shrimp to get from one pool to another similar to the way that blueberry seeds get around via bears. Bears generally do not chew berries, so the seeds remain intact. Their germination rate actually increases after having passed through the bears. When predators including trout and diving beetles consume fairy shrimp eggs or even whole female shrimp containing mature eggs, at least some of the eggs pass through the predators unharmed and may be carried long distances while in the digestive tracts of their hosts.

I encourage you, especially families with children, to visit some local vernal pools and see what you can find before they dry up. When you get there, approach slowly, look closely, and be still for a while. You will notice many more minute animals like copepods and water mites simply by being patient and having a good

look. No fancy tools are required, but little scoops, fine-mesh nets, and shallow trays are useful. Fine sieves and filters will enable you to find more of the smaller animals. If you have access to a microscope, do have a look at some pond water and algae. You will be amazed at the quantity and variety of living things that you will see.

*Matt Bowser serves as Entomologist at the Kenai National Wildlife Refuge. You can find more information at <http://www.fws.gov/refuge/kenai/> or <http://www.facebook.com/kenainationalwildliferefuge>.*



*Fairy shrimp removed from a vernal pool and photographed in a plastic tank. Credit: Matt Bowser/USFWS.*



## Marge Mullen—cherished friend of Kenai NWR for 69 years

by Candace Ward



*Marge Mullen—homesteader, community builder, and conservationist—in front of “Majesty of the Kenai” at the Kenai National Wildlife Refuge Visitor Center (credit: Walter Ward).*

Marge Mullen, a delightful 95-year-old homesteader still going strong in Soldotna, has a very unique relationship with the Kenai National Wildlife Refuge. She alone has known the Refuge for 69 of its 75 years of existence.

Marge first encountered the Refuge in August 1947 as she and her husband, Frank, originally from Chicago, journeyed from Anchorage to stake their homestead on Soldotna Creek by the Kenai River. They rode the train from Anchorage to Moose Pass and then hitched a ride to Mile 38 of the Seward Highway. They hiked for three days and 65 miles westward across the Chugach National Forest and Kenai

National Wildlife Refuge (then known as the Kenai National Moose Range) to reach their homestead destination.

Marge was equipped with a Trapper Nelson backpack and a pair of boots that she wished had been broken in better as her blistered feet attested to. She remembers encountering the Alaska Road Commission workers as they were blasting rock to build the Sterling Highway in what today is a rock face on Skilak Lake Road overlooking Upper Ohmer Lake.

Marge was also amazed at the devastated landscape resulting from a huge wild fire that had started two months before in June—as rumor had it, from the careless toss of a cigarette by a highway construction worker. She recounts that when she reached out to grab a burnt-out tree for balance, it would come out of the ground in her hand. Fortunately, most of the flames from the 300,000-acre burn had already been snuffed out by August rains. As she related, in those days there weren’t enough people or equipment to put out a fire that size.

When reaching the “Y” of the Sterling and Spur Highways, she said it looked like a “big bowl of chocolate pudding.” The Mullens staked their claims of 100 acres with coffee cans and a blaze on a tree. Over the years to follow, Marge raised her four children—Peggy, Eileen, Frank Jr. and Mary—along with digging water wells, improving the cabin, cultivating an immense vegetable garden, and rearing 800 chickens for eggs that were mostly sold at Carr’s Grocery Stores in Anchorage. In 1952, when Marge was pregnant with her fourth child Mary, Frank was struck by polio, placing even greater responsibility on her. Even with all these challenges she never wanted to return to city life.

Marge was an entrepreneur who established several businesses over the years including a laundry and The Four Seasons gourmet restaurant. She has routinely volunteered in the community at Soldotna Elementary School and for any project where an extra pair of hands was needed. Even in her 90’s, she still is very active with the Soldotna Historical Society and its homesteader museum next to Centennial

Park. It was while working for a local dentist, Dr. Calvin Fair, she became “enlightened” about conservation concerns on the Kenai Peninsula. Marge, along with Dr. Fair, Bill Schrier, Jim and Helen Fischer, Mary Miller, George Pollard, Will Troyer and John Hakala, formed the Kenai Conservation Society in the mid-1960’s.

The group took up many endeavors including stopping the flaring off of natural gas from oil operations, working to establish federal wilderness on the Kenai National Wildlife Refuge, and setting up wilderness outings for the public on the Refuge.

Marge fondly recalls all of the group’s wilderness adventures including Fuller Lakes and Surprise Creek Trails backpacking trips, route finding on the Tustumena bench lands, and tide pooling after hiking to Grewingk Glacier across Kachemak Bay. She related that Will Troyer and Calvin Fair always shook down the group members’ backpacks to make sure unnecessary gear was left behind before beginning their treks. However, she also remembers that sometimes Will would pack so light that he only had two hotdogs for food and the group would rescue him by sharing their “eats.”

Marge related that Calvin Fair and Bill Schrier were always the letter writers on issues of conservation and wilderness concern for the Kenai Conservation Society. She also proudly recounts that she testified for wilderness creation on the Kenai National Wildlife Refuge. She remembers that she was “exceedingly red” in the face, because she is a shy person and public speaking was not an easy matter for her.

The grassroots efforts of Marge and the Kenai Conservation Society were instrumental in establishing

1.35 million acres of federal wilderness in 1980 on Kenai National Wildlife Refuge—a very special legacy of scenic beauty, wildlife, and personal challenge to be enjoyed by present and future generations. The Kenai Peninsula was developed to give people livelihoods, but she has always felt that “over the long term, wilderness is the most important treasure on the peninsula.”

*Candace Ward has been a park ranger at the Kenai National Wildlife Refuge 32 years. Candace first met Marge and her daughter, Peggy, when they welcomed her to the community during her first year at the Refuge in 1984. Find more information at <http://www.fws.gov/refuge/kenai/> or <http://www.facebook.com/kenainationalwildliferefuge>.*



*The Kenai Conservation Society, whose conservation activities helped establish Kenai Wilderness, on an outing to Surprise Creek Trail in 1967 (credit: Will Troyer).*



# Remembering When

by Lindy McNeilus



*Lindy McNeilus is the new Fire Prevention and Mitigation Specialist at the Kenai National Wildlife Refuge (credit: KENWR).*

It was a warm, windy day in southern New Mexico in the 1940's when a small bear cub was rescued from a wildfire. With burned paws he was clinging to a tree when firefighters spotted the cub and took him to a local veterinarian. The frightened cub had his burns cleaned and soon made a full recovery but, unfortunately, the cub was unable to be released back into the wild. However, this bear had a higher calling. Of course we all know his name, "Smokey Bear", but what does this have to do with the Kenai Peninsula?

Well, first of all, Smokey Bear and Kenai National

Wildlife Refuge are nearly the same age. Smokey will turn 72 in July and the Refuge celebrates its 75<sup>th</sup> anniversary this year.

But, more importantly, the Kenai Peninsula has had some very serious wildfires recently, most notably the 2014 Funny River Fire and 2015 Card Street Fire. And in my new job at the Kenai Refuge as a "Fire Prevention and Mitigation Specialist", I am, in a nut shell, "Smokey's helper". As Smokey's helper, I provide you (the public) with information on how to prevent wildfires and make your property more resilient

to fire damage, by clearing and thinning vegetation that could feed a wildfire. Referred to as “defensible space”, this is the area cleared of flammable vegetation that could carry a wildfire right up to the home. Defensible space also provides firefighters with a safer place to work when they are trying to protect a home from an approaching fire.

During the Card Street Fire, I was able to realize first-hand how important it is to have defensible space around a home. The Card Street Fire had been burning for a few days when it progressed northeast of Bottenintnin Lake towards the Skilak Guard Station. Fortunately, in previous years, Kenai Refuge staff had removed many black spruce trees around the Guard Station. This tree culling proactively created defensible space that provided my fire crew an area where we could set up water tanks, pumps and sprinklers to protect this historic structure.

As the wildfire came churning through the tops of the trees, the fire crew started the pumps and retreated to a safer area near Hidden Lake. Although the fire ultimately reached the cabin clearing, the defensible space coupled with the moisture from the pumps and sprinklers prevented the fire from burning right up to the structure. Forethought and action not only prevented damage to the Guard Shack itself, but also minimized mortality of the remaining birch and spruce trees.

Fire education is another aspect of my new position here at the Kenai Refuge. Since March, I have assisted Alaska State Forestry with fire prevention outreach in schools and with events such as the “Home Show” last spring. Last week, through the University of Alaska, we hosted an ecology field trip from Elmira College in New York State that allowed students to ex-

amine the effectiveness of hazardous vegetation (fuels) reductions, as well as look at the post-fire effects and overall habitat ecology of the Funny River Fire. This summer and fall, I will be coordinating Firewise Workshops with local communities.

These educational opportunities will hopefully increase the understanding about the necessary role that some wildland fires have in maintaining a healthy fire-resilient ecosystem for plants, animals and humans that share the Kenai Peninsula. Certain plant and animal species rely on the effects of wildland fire to make the environment more hospitable for their regeneration and growth. Providing information about the natural role that fire plays in the ecosystem, while encouraging people to be fire aware and do all they can to help prevent unwanted wildland fires, will be a challenging part of my job here on the peninsula.

In my career, I have been stationed all over the country in some of the most beautiful places in the Lower 48. However, nothing compares to Alaska, with its mountain glaciers, turquoise-colored rivers, black spruce bogs, and wetlands filled with ample wildlife. As a kid, I remember relaxing around campfires and feeling the warmth of the embers while socializing with family and friends. After all those years from then to now—since transferring from northern Minnesota to the Kenai—I again feel the same warmth from both the beauty of the Kenai landscape and the friendliness of its people.

*Linden (Lindy) McNeilus is the new Fire Prevention and Mitigation Specialist for Alaska Southern Refuges. Find more information at <http://www.fws.gov/refuge/kenai/> or <http://www.facebook.com/kenainationalwildliferefuge>.*



## Smarter management of invasive plants with weed-free gravel

by Jen Peura



*Participants in a class to train weed-free forage and gravel inspectors conduct a mock inspection of a Soldotna gravel pit on May 6, 2016 (credit: Heidi Chay).*

Last autumn, as I strolled through downtown Anchorage to meet a friend at Snow City Cafe, I gazed downward, in constant scrutiny of the flora along the sidewalk. The bold purple blooms of bird vetch with its delicate, thin spiraled stem commanded my attention—I find its unwanted beauty revolting for it climbs over and chokes out our native plants. The cheerful yellow pops from clusters of butter-and-eggs, another plant that invokes an overreaction of dis-

dain for its toxicity to grazing animals, absorbed my thoughts. Where there is one patch, there's a heightened chance of finding another nearby, and so the search intensifies. And that's when, in a state of compulsive observation and mental annotation, I realize I am consumed in work mode and laugh at myself.

This same, slightly-neurotic quest happens in my own yard, where I mercilessly dug the root system out from under charming oxeye daisies last summer.

I then moved on to painstakingly pull the mint leafed hemp-nettle from a gravel corner of my yard. I can't help but wonder if the hemp-nettle arrived with the gravel. Did this weed infiltrate my yard because it was growing in the source gravel pit? And where is this gravel pit? How many other locations around the Kenai Peninsula now have this weed because of a "typhoid Mary" gravel pit?

It was precisely this kind of thinking that prompted the State's Division of Agriculture (within the Department of Natural Resources) to launch the Certified Weed-Free Gravel and Forage programs in 2010. Soil & Water Conservation Districts in Kenai and Homer administer the programs locally.

Three years ago an opportunity arose to use the certified weed-free gravel program to help better manage invasive plants on the Kenai National Wildlife Refuge. In 2012, when Hilcorp Alaska acquired the Swanson River oil and gas lease, and commercial activities were renewed within the Refuge, the Refuge required the use of certified weed-free gravel for maintenance of well pads and roads. Hilcorp then leveraged this action by developing its own Invasive Species Management Plan last year, not only for the Swanson River Unit, but also the Beaver Creek and Birch Hill Units.

The Refuge will also require the Alaska Department of Transportation & Public Facilities to use certified weed-free gravel on their project, slated to begin this summer, to improve 22 miles of the Sterling Highway. Most of the stretch from MP 58–79 is within the Refuge, including a new bridge over the East Fork of the Moose River. Although headwaters of most of our salmon streams are protected with the Refuge, and the East Fork of the Moose is no exception, roads that intersect them are vectors for the introduction of invasive plants. Perhaps the worst offender is reed canary grass, which unfortunately has encroached and ultimately destroyed instream habitat in the Midwest and Pacific Northwest.

Earlier this month, local gravel suppliers had an opportunity to learn what's involved in maintaining a certified weed-free gravel pit at a workshop sponsored by the Kenai Peninsula Cooperative Weed Management Area (hint: non-invasive weeds are okay.) Janice Chumley, with the University of Alaska Fairbanks Cooperative Extension Service, is one of several trained inspectors who can certify pits and offer options for tackling any invasive plants that are found. Certification is completely voluntary. The inspection request form and information regarding weed-free standards can be found at <http://plants.alaska.gov/invasives/weed-free-gravel.htm> or by calling the Kenai Soil & Water Conservation District (283-8732).

Demand for weed-free gravel has created the need for sources, and an opportunity for gravel suppliers to fill this niche, the same way an increased demand for weed-free forage has created a business niche for local growers. I hope to see soil become the next step. Restoration and construction projects on the Refuge need certified weed-free soil and, ideally, a supplier will soon be able to fill this niche as well once the state defines those requirements for certification.

Although weed-free gravel, forage, and soil are slightly more expensive, the long term cost effectiveness weighs heavily in its favor. Detecting, treating and monitoring invasive plants requires staff dedicated to those purposes as well as costs associated with herbicide application, which is both monetarily and environmentally taxing. It is by safeguarding fish and wildlife populations and habitats, and thereby protecting commercial and recreational opportunities, that the weed-free policy supplies long term economic benefits to the Kenai Peninsula.

*Jen Peura is a seasonal biotech at the Kenai National Wildlife Refuge. Find more information at <http://www.fws.gov/refuge/kenai/> or <http://www.facebook.com/kenainationalwildliferefuge>. More information on invasive plants can be found at <http://www.kenaiweeds.org>.*



## 2016 Summer Fun at Kenai National Wildlife Refuge

by Candace Ward



*Join award winning cinema photographers, Kennan and Karen Ward, for a free showing of their new Big Sur film—Redwoods to the Sea—on Saturday, June 4, at 11 AM at the Kenai National Wildlife Refuge Visitor Center.*

On Saturday, June 4, the Kenai National Wildlife Refuge kicks off our summer programs with a very special program. At 11 AM, cinematographers Kennan and Karen Ward will share their 90 minute film—Big Sur—Redwoods to the Sea. The film shares the fascinating stories of the wildlife and people of this rugged, wild land. Of special interest is the incredible high definition visual clarity of the cinematography done with red 4K HD cameras and aerial drone camera work. Other attractions include the story of reintroduced endangered Condors raising their first young born in the wild in over 35 years.

Before and after the film, Karen and Kennan will share their experiences as photographers and cinematographers in wild places around the world including many years in Alaska from southeast Alaska to the arctic and even on our own Kenai Peninsula. In our visitor center book store, their beautiful Alaska wildlife posters and grizzly growth charts are available for sale. Sale proceeds are used to support the Refuge's nature education programs.

On Sunday, June 5, at 2 PM celebrate National Trails Day with Ranger Nick Longobardi, who will

guide you for a 2-mile hike on the Refuge Visitor Center Centennial Trail. Wear comfortable closed-toed shoes, dress for the weather, and bring your insect repellent. No dogs on this hike.

During the June 11–12 weekend, visit the U. S. Fish & Wildlife Service booth at the Kenai River Festival at Soldotna Creek Park for hands-on fishy fun for kids of all ages.

Beginning in mid-June and running through mid-August, Refuge staff will host a variety of wildlife and cultural interpretive programs every Thursday, Friday, Saturday and Sunday.

Every Thursday at 2 PM, from June 16 to August 4, participate in the Family Explorer Program. These hands-on exploration programs are specially designed for families. June programs in the series are Fire in the Forest (June 16), Be Bear Aware (June 23), and Wetland Dipnetting (June 30).

On Fridays at 1 PM, from June 17 to August 12, join Refuge staff on afternoon Discovery Hikes lasting 2–2½ hours in the Skilak Wildlife Recreation Area. Wear comfortable hiking boots, bring water and insect repellent, and dress for the weather. No dogs on these

hikes. For the first two hikes, meet staff at the trail head—Hidden Creek Trail (June 17) and Hideout Trail (June 24).

On Fridays at 2 PM, from June 17 to August 19, enjoy the Tale of Two Cabins. Are you curious about the historic Andrew Berg and Elwell cabins at the Refuge Visitor Center complex? Learn more about Refuge and Kenai Peninsula history as Refuge staff lead tours of the cabins and share the lost stories of our early settlers.



*Join Ranger Michelle Ostrowski and other educational and outreach staff for some summer fun at Kenai National Wildlife Refuge!*

On Saturdays at 2 PM, from June through Labor Day, join us for the Saturday Showcase. These programs highlight the variety of attractions on the Refuge. The first month's programs are Wetlands & Woods Nature Walk (June 4), Sockeye Fishing for Beginners (June 11), Wildflowers of the Kenai (June 18), and Nature Photo Safari (June 25).

On Sundays at 2 PM, from June 17 to August 21, come out on a ranger-led Fitness Hike on the Visitor Center Centennial Trail. This hike is designed to move at a steady pace over two miles of rolling woodlands. Wear comfortable closed-toed shoes, dress for the weather, and bring your insect repellent. No dogs on this hike.

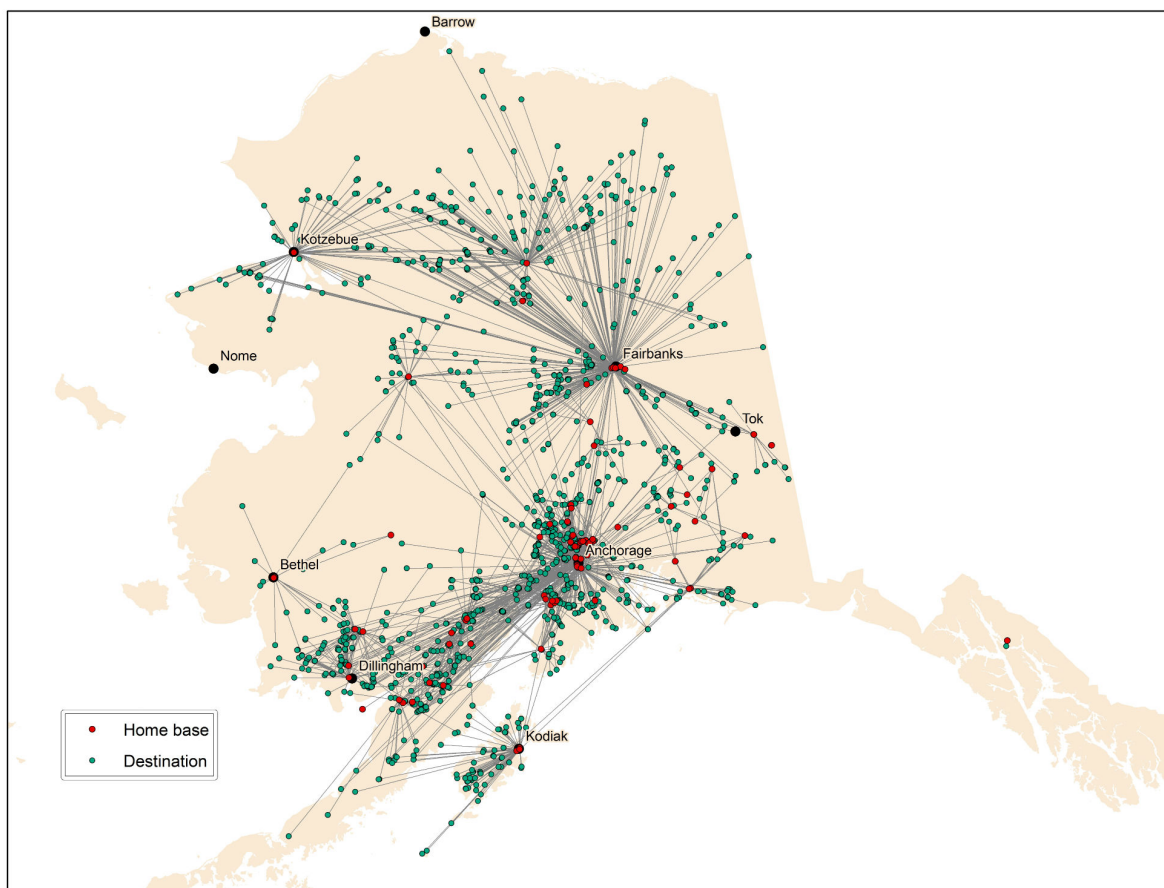
Please contact us at the Refuge Visitor Center for specific programs in July and August at 260-2820. Also, monthly program schedules are available at the Visitor Center and are posted on our website (<https://www.fws.gov/refuge/kenai/>). If you would like to be put on a listserv for Refuge programs, contact Michelle Ostrowski at 260-2839 or [michelle\\_ostrowski@fws.gov](mailto:michelle_ostrowski@fws.gov).

We look forward to you joining us for summer fun at the Kenai National Wildlife Refuge!

*Candace Ward leads the Refuge's Information and Education Program and has been a park ranger for over 30 years. For more information on educational programs, contact the Kenai National Wildlife Refuge Visitor Center daily from 9 AM to 5 PM at 260-2820.*

# Elodea gone from the Kenai Peninsula?

by John Morton



*Locations of some commercial float-plane operations and their destinations show the potential routes of Elodea dispersal across Alaska. Float plane traffic, not the aquarium trade, is now the primary vector for likely re-introduction of Elodea to the Kenai Peninsula from Anchorage and Cordova (Tobias Schwoerer, UAA-ISER).*

The good news is that Elodea, the first submerged freshwater invasive plant to make it to Alaska, may be gone from the Kenai Peninsula. Last week, Kenai National Wildlife Refuge biologists re-surveyed 50 sites in each of the three lakes on the Kenai Peninsula in which Elodea is (or was) known to occur. When these lakes north of Nikiski were first surveyed in May 2014, just prior to herbicide treatments, Elodea was present on 70 percent of Beck Lake sites, 50 percent of Stormy Lake sites, and 22 percent of Daniels Lake sites. Now, two years later, we can find no trace of Elodea on these 150 sites or any other places we have sampled with

throw rakes.

Elodea really is one of the nastier invasives, able to grow so abundantly under the right conditions that it can alter water chemistry, degrade spawning habitat, hinder boat and float-plane traffic, and reduce property values. And it spreads so easily! Because it can reproduce asexually, a single fragment from an aquarium dump or carried by a floatplane can be the start of a new infestation.

Success to date is partially the result of a highly collaborative effort to eradicate Elodea that involved the U.S. Fish and Wildlife Service, Alaska Department



of Natural Resources, Homer Soil & Water Conservation District, Kenai Peninsula Borough, Kenai Watershed Forum, University of Alaska Fairbanks Cooperative Extension Service, Cook Inlet Aquaculture Association, Alaska Department of Fish & Game, and some helpful residents from Beck and Daniels Lakes. We received great technical input from Dr. Lars Anderson, an invasive aquatic plant expert from the University of California-Davis, folks from SePRO Corporation, the manufacturer of fluridone (the herbicide we used), and Dr. Don Les from the University of Connecticut-Storrs who identified our uninvited pest as a hybrid.



*Spawning sockeye in Daniels Lake are beneficiaries of collaborative efforts to eradicate Elodea from the Kenai Peninsula (Scott Shuler, SePRO).*

Our success is also partially due to Elodea's unusual reproductive biology. While Elodea can reproduce asexually from a single plant fragment, Elodea is also dioecious, meaning that the male and female parts are on different plants, so both sexes need to be present to produce seeds. Elodea on the Kenai fortuitously appears to have originated from a single-sex population so we don't have to deal with a seed bank that can persist for years at the bottom of our lakes.

Nonetheless, we are far from being done with Elodea on the Kenai Peninsula. We will continue monitoring aquatic plant populations in these three lakes over the next two or three years, ensuring that Elodea really is eradicated and that native flora recover. We remain suspicious that Elodea might be in Bishop Creek, into which Beck and Daniels Lakes drain, but Elodea has yet to be detected there despite multiple canoe trips.

We will also continue to monitor fluridone concentrations in both water and sediment in the three lakes. Fluridone initially degrades by solar UV radiation and ultimately by temperature-dependent microbial action once bound in the sediment. As other infested areas in Alaska are now being treated with fluridone, the persistence of fluridone in our cold environment is a question being asked by others that we hope to address.

We think Elodea was introduced initially to Beck Lake by aquariums dumped from a small freshwater and tropical fish shop near the corner of Halibouty and Dragon Fly Roads that went out of business in the 1990s. Elodea probably barely survived the early years as the two parental species of our hybrid are native to much warmer and more nutrient-rich waters in the Midwest. Eventually, however, it adapted to the Kenai Lowlands and then began to grow quickly.

This scenario is plausible because when we sent live specimens from our lakes down to Fort Collins where Dr. Andrew Skibo from SePRO planned to test fluridone's lethality, he couldn't get this supposedly invasive hybrid to grow in the warm waters of the laboratory environment! When a second batch we sent him wouldn't grow, Andrew had the bright idea of dropping the temperature in the growth chambers and that was all it took for the plant fragments to begin rapid cloning. This adaptation to colder waters has likely occurred independently in Elodea populations introduced from aquarium dumps into waters around Cordova, Fairbanks and Anchorage.

With the Alaska Division of Agriculture's quarantine on importing Elodea in 2014, the aquarium trade is not likely to be the primary vector for future spread of Elodea. However, now that there are established populations elsewhere in Alaska, our biggest concern is that Elodea will be (or already has been) reintroduced to the Kenai Peninsula by a float-plane from Anchorage or Cordova. And with these populations already being cold-adapted, Elodea will fare well in whatever new waterbodies they end up in.

So even with our good news comes the bad news that we need to remain vigilant. An easy way to report suspected Elodea is to take a close-up photo with your phone camera and email it to me at [john\\_m\\_morton@fws.gov](mailto:john_m_morton@fws.gov). With over 4,000 lakes on the peninsula, all eyes are needed!

*Dr. John Morton is the supervisory biologist at Kenai National Wildlife Refuge. Find more information at <http://www.fws.gov/refuge/kenai/> or <http://www.facebook.com/kenainationalwildliferefuge>.*

## The cat is out of the house

by Todd Eskelin



*A cat posing with its trophy, an Orange-crowned Warbler. Photo by Todd Eskelin, USFWS.*

The debate over whether cats should be confined indoors or allowed to roam outside is one that affects many people personally. Often it comes down to a conflict between a neighbor who does not like to see cats in their yard or discover cat feces in their garden and the cat lover who thinks their pet does not cause any problems and should be allowed to walk around outside and enjoy the sunshine. Many outdoor cat owners will tell you that they feel guilty keeping a cat “imprisoned”, and don’t feel it would be a good life if they couldn’t go outside. Let me preface this story with the fact that I have a strictly inside cat. I have read many of the studies that try to estimate the number of birds killed annually by our feline pets and can’t fathom numbers in the billions.

This spring while on a family vacation, we spent time at a friend’s house on the outskirts of Los Angeles. This was a beautiful neighborhood with tons of trees and brush lining the back of their property.

Viewed on Google Earth it was apparent they lived very much in a green belt with miles of pavement covering the landscape in all directions. I envisioned the birding was going to be awesome as there was no other place for birds to be than this “green” neighborhood. This was going to be like birding in New York City’s Central Park.

Upon arrival I noticed a few cats in the back yard and my dreams of a birding Mecca were soon dashed. The owners are super nice and caring people and what they had been doing is feeding the stray cats in the neighborhood, catching them and paying to have them neutered or spayed, and then releasing them. I asked how many cats they were feeding and they reported that in the last few years they had captured at least 50 different cats. Again, these are nice people that truly care about all animals, trying to fix a problem they did not create.

The next morning I awoke early to see what birds

might still be around and the neighborhood was full of song! There were birds in the tall poplar and citrus trees in the back yard including Cedar Waxwings, Orange-crowned Warblers and several Black-chinned Hummingbirds. The level of devastation these cats were having on the wild bird population was not apparent until we drove to a nearby park where there were no (or at least fewer) free ranging cats. As soon as I got into similar habitat with no cats I was seeing the same species from the back yard and many more. The most striking difference was the number of different species of sparrows in the cat free area. Then it dawned on me and I pulled out my list to confirm. The only species I saw in the back yard of our friend's house were birds that lived high in the tree canopy. Not a single ground dwelling bird remained in the cat-rich area. On the surface it seemed like there were lots of birds flitting around and singing, but it was a barren wasteland for ground-loving species.

So let's do some quick math. There are estimates of 85 million cats with owners in the U.S. (pet cats). There are possibly an additional 70 million ownerless (feral) cats. Roughly 78% of pet cats spend time outdoors (58.5 million). A study conducted by Kerrie Anne Loyd at the University of Georgia, using cameras attached to 60 urban cats showed what cats do when they are "out". Thirty percent of the study cats successfully killed prey including lizards, voles, chipmunks, birds,

frogs, and snakes. It is risky to extrapolate the results from this study to the rest of the U.S., but let's do it for conversation sake. Pet cats would only have to kill a bird once every 3 weeks to reach 1 billion dead birds annually. The 70 million feral cats are likely killing many more birds, so 1 billion dead birds is not a stretch at all.

The study also found that less than 25% of the kills were brought back to the house. Most owners probably have no idea what their cats are actually catching while they are out. If your cat is bringing a bird back to the house once every 84 days (almost 3 months), that is enough to produce 1 billion dead birds from pet cats alone. We are also entering the time of year when baby birds are popping out flightless and wandering around until they get their wings. They don't stand a chance against free ranging pet or feral cats. One third of all bird species in North America are declining and it is likely the hurdles faced by these species will not get any easier. Is it time to reevaluate what it means to be a responsible cat owner in the U.S.? If we are going to curb the decline in bird species across North America it starts with finding inside homes for cats, not out.

*Todd Eskelin is a Wildlife Biologist at the Kenai National Wildlife Refuge. He specializes in birds and has conducted research on songbirds in many areas of the state.*



## Marine-derived nutrients: What goes around comes around

by John Morton



*Brown bears help transport the nutrients acquired in the ocean by salmon to the terrestrial system where it can have cascading effects on riparian vegetation and even bird communities. The average female brown bear on the Kenai Peninsula deposits 80 pounds of marine-derived nitrogen in the terrestrial ecosystem each year (photo credit: Berkley Bedell).*

As early runs of king and sockeye return to streams of the Kenai Peninsula, they bring more than the roe and milt that brings about the cycle of life. The very nature of anadromous fish is that they also carry the carbon, nitrogen, phosphorus and other minerals stored in their bodies after years of growing in the high seas.

Their hoped-for evolutionary fate is to die after successfully spawning. But along the way, nutrients stored in their bodies and roe are excreted

by live salmon and released from decomposing carcasses, energizing a complex food web that includes phytoplankton, benthic invertebrates, predators, scavengers, riparian vegetation, and even song bird populations. Called “marine-derived nutrients” (or MDN), it is the mechanism by which salmon link marine and terrestrial ecosystems via a freshwater conduit that is truly cosmic—literally, what goes around comes around.

Consider that an adult chum salmon returning to

spawn contains 130 grams of nitrogen and 20 grams of phosphorus. I couldn't find comparable data for sockeye but, for the sake of argument, let's say they're the same. With a late run of 1.7 million sockeye in the Kenai River, that translates to a potential input of half-a-million pounds of nitrogen and 75,000 pounds of phosphorus into the watershed every year!

MDN can be tracked through the food web by examining the ratios of stable isotope tracers, typically of carbon or nitrogen, and sometimes sulfur. The relative contribution of these elements from marine versus freshwater nutrient sources can be assessed because spawning salmon contain higher proportions of the heavier isotopic form (more neutrons). What's cool is that there has been some great research on MDN here on the Kenai Peninsula.

Dr. Dan Rinella, originally with the University of Alaska Anchorage and now with the U.S. Fish and Wildlife Service, worked with others on several streams on the western Kenai Peninsula to demonstrate that MDN in aquatic macroinvertebrates and juvenile Dolly Varden increased with increasing salmon returns. In other words, these organisms respond positively to MDN transported into the freshwater environment by returning salmon. More impressive was that elevated MDN levels were maintained in these organisms for at least nine months after spawning, indicating that today's returns affect the next growing season.

And, of course, other fish eat these nutrient-enhanced invertebrates as well as roe. A researcher in Washington found that juvenile coho doubled their growth rate after returning adults spawned whereas the growth rate of juvenile trout in nearby non-anadromous streams remained the same. I found one National Park Service presentation online that suggested up to 95% of food consumed by a salmon fry may have originated from the salmon carcasses of its "parents"!

This nutrient multiplier effect carries over to riparian vegetation, a beneficiary of scavenging and fishing eagles, bears, ravens, gulls, river otters and mink, all of which leave salmon remains on stream banks. For example, a study published in the journal *Ursus* by Dr. Grant Hilderbrand and others found that 15 to 18 percent of nitrogen in white spruce within 500 meters of Mystery Creek and the Killey River, two anadromous streams on the Kenai National Wildlife Refuge, were marine-derived. Research elsewhere indicates 10 to 70 percent of nitrogen in riparian foliage comes from salmon. This fertilizer effect means that foliage grows faster and presumably lusher—a study on Chichigof Island in Southeast Alaska found that Sitka spruce growth rates were three times faster at spawning sites than non-spawning sites.

You might guess that richer riparian vegetation, nutrient-enhanced invertebrates, and abundant salmon carcasses would affect song bird populations as well. Indeed, a study of salmon streams in coastal British Columbia found that breeding densities of winter wren, Swainson's thrush, varied thrush, Pacific-slope flycatcher, and golden-crowned kinglet were about half on stream reaches above waterfalls (without salmon) as those below waterfalls (with salmon).

I encourage you to take a look at *Salmon in the Trees*, a book with wonderful illustrations and photographs about the role that salmon (and MDN) plays in sustaining the Tongass rainforest ecosystem in Southeast Alaska. It gives one pause as we go about our seasonal business of using gill nets and fishing lines and dipnets to intercept salmon returning to Kenai ecosystems. Our harvest today may well affect the productivity of our salmon tomorrow—yet another reminder of what goes around comes around.

*Dr. John Morton is the supervisory biologist at Kenai National Wildlife Refuge. Find more information at <http://www.fws.gov/refuge/kenai/> or <http://www.facebook.com/kenainationalwildliferefuge>.*



# Kenaitze youth dig into their past at Susten Archaeology Camp

by Leah Eskelin



*Susten campers carefully excavate a cache pit found on the Kenai National Wildlife Refuge.*

There is a subtle little path leading into the woods off of a quiet dirt road deep in the Kenai National Wildlife Refuge. It whispers now, as the little plants perk back up, and will soon stop telling the story of a busy week with 50 boot-clad feet travelling back and forth between the gravel and a little forest clearing. It's not hard to see how game trails are created when looking at this little path, with each traveler following in a neat line. But it wasn't a train of bears or moose who passed by here. It was a happy group of campers, led by an experienced team of counselors and scientists, who travelled to and from the clearing last week.

The Kenaitze Indian Tribe's Susten Archaeology Camp has been going strong on the Kenai National Wildlife Refuge for over 20 years, connecting Alaska

native youth to their cultural heritage through studying the landscape, discovering subtle depressions in the ground and excavating these cache pits (called "elnen t'uh" in Dena'ina) with the oversight of the group's archaeologist, Debbie Corbett, who retired from the U.S. Fish and Wildlife Service a few years ago. This year's study site was discovered by last year's campers, and some of the same kids were back a second year to dig into what they had found together.

What is there to find in these pits? It's a glimpse into the past just like all archeological projects, but on a more subtle level. Only rarely are human tools or other man-made materials found in the caches. Often only charcoal, fire-cracked rocks and disruptions in the soil layers are evidence of past generations. Why? It's really a beautiful reason. The Dena'ina people, who once sat in the same clearing in the woods hundreds of years before we stopped for a visit, believed that every personal item or tool they used collected information about themselves, information that could be used against them by someone up to no good. As a result of this belief, personal things were just not discarded like we are apt to do now. Torn clothes were mended, broken tools were fixed and, when they were well and truly used up, they were burned or destroyed, leaving not a trace.

Even the manner in which fish was stored in the cache pits was designed to be efficient, effective and temporary. Once the pit was dug, layers of grass would be used to separate the frozen fish forming a repeating pattern: fish, grass, fish, grass... It was a natural cold storage method that provided for the tribe all winter long.

It's a far cry from the annual frozen fish freezer clear out we witness this time of year as modern Alaskans empty out perfectly fine fillets to make room for new vacuum sealed bags this summer. We could learn a thing or two about respectfully using our resources and not creating waste from the ancient people whose natural "freezers" we dug into last week.

I participated in Susten Camp this year as an interpretive Refuge Ranger, leading vegetation surveys,



insect dipnetting and digital photography activities for the group. My goal was to help connect the campers with the natural world around them while they connected to their cultural heritage. We collected photos of the plants and animals (mostly insects if you don't count our single brown bear sighting and some moose nuggets) found at each dig site and identified the things we knew in the field. The unknown species were documented by photos for future identification by Refuge biologists through our project site on inaturalist.org (<http://www.inaturalist.org/projects/susten-camp-2016>). Some insects we found during our bug hunts and dipnetting were collected for DNA analysis and cataloging by the Refuge.



*This sawyer beetle found its way into an excavated pit on day two. A camper's trowel helped it find a safe way out.*

Back at camp, we combined the natural and cultural heritage lessons of the week during a language activity. The campers worked together to translate the English common names of each identified species we documented into the Upper Cook Inlet dialect of their Dena'ina language. Prickly Rose was introduced by its other name, "*heshkegh*", which means "big thorn." Club moss, found in great carpets in the clearing, is "*dlin'a kajada*", meaning "mouse's tail bone."

I learned about an amazing group of people, ancient and modern, and their techniques of reusing resources and living light on the land last week. Likewise, we all learned how to see the details in the nature world, being observant, patient, and sometimes brave as we photographed insects that were a little scary looking.

This leads me to the really impressive thing I saw last week—teens who were empowered to excavate important archeological finds. What's more, they completed the task with patience, dedication and care. Do you know one teenager who can spend a full week outside of cell coverage, cooperating with other students, following scientific procedures, and staying cheerful despite biting flies? Can you name two? Three? I am pleased to say that after this past week, I can name 19!

*Leah Eskelin is a Visitor Services Park Ranger at the Kenai National Wildlife Refuge who loves bringing fun hands-on nature programs to the public every month. Join the summer fun by checking out the events schedule at <http://www.fws.gov/refuge/kenai/> or <http://www.facebook.com/kenainationalwildliferefuge>.*

# Moss piglets? More common than you think on the Kenai

by Rebekah Brassfield



*Side view of a moss piglet with the head on the right side of the photo, and the last of four pairs of legs on the left side. This tardigrade is 0.4 mm long and was collected on the Kenai National Wildlife Refuge (credit: R. Brassfield).*

Mosses and lichens are among the most abundant plants on the Kenai Peninsula, both of which contribute to the ecosystem on a large scale. But at the microscopic level, they are home to an astounding number of organisms, including an invertebrate called a tardigrade and, in some circles, a water bear or moss piglet. They have eight legs with complex claws at the apex of each, and are slightly smaller than the period at the end of this sentence.

The photographs may make them look agile but, in reality, they bumble around their environment slowly and use their claws to hold on to the debris that is often found in moss or lichen. The slightest current can pull them away, and their claws don't work well as boat paddles, making swimming difficult. In fact, the name Tardigrada means "slow stepper". Quite coincidentally, it was given that Latin name in 1776, a special year that we celebrate every 4<sup>th</sup> of July.

Perhaps the most fascinating feature of the tardigrade is their ability to enter a hibernation stage known as cryptobiosis. During adverse environmental conditions such as drought, flood, and changes in air pressures, they can put all their biological processes

on hold like a pause button. In times of drought, they shrivel up like a microscopic raisin and can stay like that until water levels return to normal, sometimes for 30 or more years!

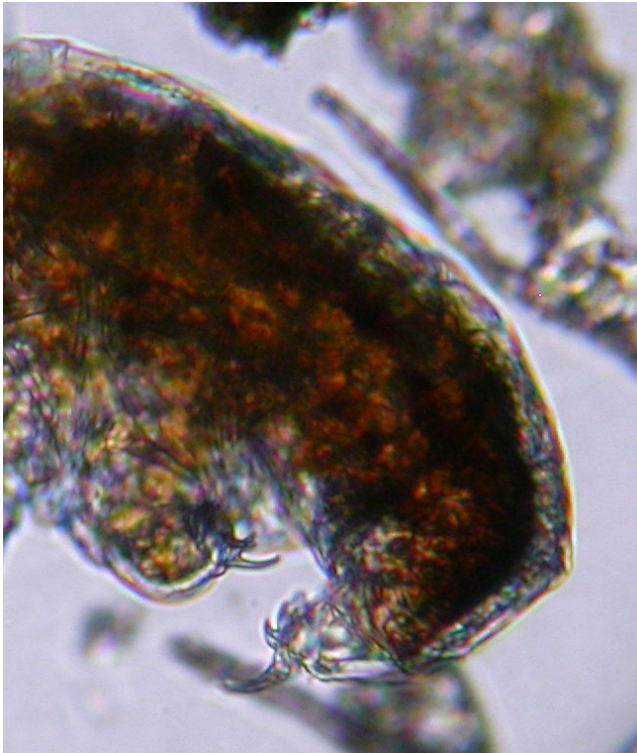
During floods, the opposite happens. They swell up like a balloon and bounce around safely until water recedes. This is an important adaptation because at the microscopic level even the slightest change in temperature or water can drastically affect its inhabitants. Without the ability to enter the cryptobiotic stage, tardigrades would likely be extinct.

Tardigrades are considered "extremophiles" which means they live in the most extreme places on earth. They have been found on mountain tops where cold winds and low pressure are common companions. They are also in deep sea vents that spit out sulfuric acid and boiling water. But they don't just call those places home—they can be found in freshwater streams and lakes, saltwater flats, estuaries, and in leaf litter on the ground. They are most commonly collected on moss and lichen because of the ease of collection, and because they can be found right in your backyard.

I collected a small sample of caribou lichen in



the woods just behind the Kenai National Wildlife Refuge's Headquarters on Ski Hill Road. I put it in a dish of water overnight to see what species of tardigrade lived in the area. Almost immediately after placing the slide under the microscope, I spotted a tardigrade crawling around on debris. Beside tardigrades, I observed mites, rotifers, and nematodes, truly a diverse community. Both tardigrades I collected and identified were from the genus *Macrobiotus*, which is the most common genus in Alaska. Unfortunately, identification to species requires high powered microscopes and, in some cases, the specimen's eggs.



*Close up view of a tardigrade's claws that can range from two small "Y" shaped points to oddly-shaped barbed fish hooks depending on the species (credit: R. Brassfield).*

What do tardigrades do? This is a tricky question, and one I get asked often. It is important to know the purpose of organisms and research. I had a professor call it "taking up space". All organisms take up space, and tardigrades are no exception. They eat rotifers and nematodes, which are also common microorganisms. Tardigrades exist in many unique microscopic habitats which might have different inhabitants without the predation and competition for resources posed by tardigrades.

Tardigrade research is an ongoing effort by biologists and even researchers at NASA. In 2007, NASA launched two colonies of tardigrades into space to take a closer look at how radiation affects living cells, searching for possible enhancements to manned space missions in the future. Not only were they the first organism to survive the vacuum of space and sub-zero temperatures, tardigrades also showed an ability to decrease the effects of solar radiation and oxidative stress—a potential cause of many human diseases including Parkinson's and Alzheimer's. There is continued research on tardigrades in space, and they are a common addition to most space missions.

Although we don't know much about their life cycle or their ecology, they could be valuable in unforeseeable ways. So take a look in your back yard—odds are it is teaming with life and almost certainly tardigrades.

*Rebekah Brassfield is a biological intern at Kenai National Wildlife Refuge. She is an undergraduate student at Concordia University in Nebraska, majoring in Conservation Biology. Find more information at <http://www.fws.gov/refuge/kenai/> or <http://www.facebook.com/kenainationalwildliferefuge>.*



## Coyote ecology on the Kenai Peninsula

by Ted Bailey



*Coyotes, now common on the Kenai Peninsula, naturally colonized the peninsula in the early 1900s. They are perhaps the most adaptable carnivore in North America.*

Coyotes are perhaps the most adaptable carnivore in North America, ranging from the Atlantic to the Pacific coasts and from Central America north to Interior Alaska. They live in remote wilderness areas as well as urban areas, and have been seen in city parks in New York, Chicago and Los Angeles.

When coyotes began moving north and were first reported on the Kenai Peninsula in the early 1900s, they found the peninsula free of wolves and thus colonized it without having to compete with their larger aggressive cousins. But concern then about the

widespread presence of coyotes on the Peninsula resulted in bounties placed on coyotes and, combined with the value of their pelts, provided a source of winter income for trappers on the peninsula in the 1930s and 1940s. By the 1960s, wolves from mainland Alaska began to naturally re-colonize the Kenai after having been extirpated for nearly a half-century, only to discover that coyotes had become well established in their absence.

When Dr. Rolf Peterson and Jim Woolington began, and I later joined, the Kenai Peninsula's first

wolf study, radio collars were also fitted on coyotes incidentally-captured from 1976 to 1980 on the Kenai National Moose Range (later to become the Kenai National Wildlife Refuge). At that time coyote home ranges overlapped those of wolves and averaged 40.1 and 27.8 square miles for male and female coyotes, respectively. Coyotes ate primarily snowshoe hares, porcupines and other small mammals. Coyotes were captured more often near public roads than near roads closed to public access likely because of interference competition with wolves. During that study, eight instances of wolves killing coyotes were documented.

Later, from 1987 to 1991, University of Alaska Fairbanks graduate student Win Staples conducted research on coyotes and lynx on the Refuge when the snowshoe hare population was low. He discovered that although coyotes continued to feed on scarce hares, coyotes fed primarily by scavenging carcasses of moose that were often killed by wolves during winter. This behavior often brought coyotes in direct contact with wolves and, as in the earlier study, Staples reported that three of his sixteen radio-collared coyotes whose fates were known had been killed by wolves and four by humans. Thus, given the opportunity, wolves will kill coyotes (but usually do not eat them). Not surprisingly, coyotes learn to avoid wolves but may also become dependent on them for food in the form of moose carcasses.

Staples also reported that coyotes scavenged from the carcass of a moose that was injured when struck by a vehicle and wandered off the road before dying. Coyotes also scavenged on spawned-out salmon carcasses along the Kenai River, and occasionally killed small free-roaming (unpenned) domestic ducks and rabbits, and killed and partially ate two dogs (cocker spaniel and beagle) in the off-refuge, human-developed Sterling Corridor.

In addition to co-existing with wolves on the Refuge, coyotes on the northern peninsula also inhabit areas outside the Refuge seldom used by packs of wolves such as the Sterling Corridor and other human-dominated areas around Soldotna, Kenai and Nikiski and the Kenai River Flats where they are sometimes mistaken for wolves.

Once while radio-tracking wolves from an aircraft, I observed a coyote approaching a pack of wolves unaware they were just behind a nearby ridge and thus unseen by the coyote. The wolves immediately pursued the approaching coyote when they first spotted it. However, the fast running coyote outdistanced the wolves which just as quickly abandoned the chase. Had the snow been deeper and the coyote unable to run as swiftly, the outcome may have been different.

Elsewhere, a study of coyotes and wolves in Yellowstone National Park revealed that after wolves were introduced there in 1995, 75 percent of 337 observed wolf-coyote interactions occurred at ungulate carcass sites, and that wolves initiated 85 percent of the encounters, dominating most of the interactions. Wolves chased coyotes without physical contact 79 percent of the time and killed coyotes only during 7 percent of the interactions. Other findings were that wolf-coyote interactions decreased over time, wolves were the dominant canid, and coyotes probably benefit from the access to carrion at wolf-killed carcasses.

Coyotes now live in most habitats in North America including those dominated by humans and among wolves, their most significant natural competitor, but it can be a dangerous life. Fortunately for coyotes, they are one of the nature's supreme adaptors.

*Dr. Ted Bailey is a retired Kenai National Wildlife Refuge wildlife biologist who has lived on the Kenai Peninsula for over 40 years. He maintains a keen interest in our local wildlife and natural history.*

# Wildlife viewing through augmented reality: it's a new game

by Leah Eskelin



*This virtual snake, an Ekans, was spotted at the Refuge Visitor Center through the augmented reality of Pokémon Go. No real snakes are found in the state otherwise.*

Driving past the Refuge entrance sign last week, a group of boys gathered nearby caught my attention. It's an unusual hangout spot, so I stopped to check that everything was okay. Everything was, except one of the boys had run out of Pokéballs and was picking some up from the sign. I smiled, knowing what was

going on, and asked them how many Pokémon they each had in their Pokédex. We compared creatures sightings, stopped to watch a Mallard duck fly over our heads, chatted about a moose these friends had seen together, and then parted ways. The boys headed to Soldotna, walking towards a few more PokéStops and a gym while I headed to work, where I welcome Refuge visitors to the Kenai, and often have very similar conversations over bird identification books and mammal lists as I had over our collective smartphones moments earlier. The park ranger in me, who loves seeing people spend time outside during the beautiful Alaskan summer, was happy about both wildlife viewing groups, virtual and those in real life. So just what were those boys doing? You likely already guessed: playing the wildly popular app Pokémon Go, a revival of a cherished childhood game of the mid-90s.

Bridging the virtual and real worlds, the wildly popular game Pokémon Go leads participants called “trainers” through a scavenger hunt of sorts, hunting for mythical creatures, stopping to refill supplies at aptly named PokéStops and gathering to test the strength of their collected pocket monsters against each other at “gyms.” All this action takes place through smartphones on an overlay of Google map data, so despite sounding like just another role playing game, Pokémon Go is creating an augmented reality, a mix of real and virtual, using smartphone or tablet cameras and their GPS features.

Trainers don't just travel to different PokéStops within the game. They walk on real streets, in real parks, and through real communities on their journey. They travel for miles, and not as often by car as other methods since moving faster than 20 miles per hour means their eggs can't incubate. (Just follow along here, this game has many layers, each discovered in time by the participants without help from an instruction manual.) This is a game that requires spending time outside to be successful. This is exciting! There has already been plenty of online discussion about this “walk in the real world” phenomenon. What I like to take from it all is that a huge number of people are



spending their summer outside, getting to know their cities and towns, meeting new friends and exploring. Pokémon Go encourages social interaction, outdoor exercise, and consideration, to some extent, of nature. These are the goals of park rangers across the country: to connect people to the great outdoors. Now, it is happening in a very big way. This game already has over 21 million daily users.

Pokémon Go is interesting in part because the game uses information from Google to place virtual Pokémon in real habitats. For example, you are much more likely to find a water-type Pokémon near real water like a lake, beach or river than in the middle of a desert. Also, players can discover new places they may not have previously visited. For example, the Refuge sign at the bottom of Ski Hill Road where I met that group of boys is a designated PokéStop. Last summer, they admitted during our quick chat, they spent most days indoors playing video games. For them, and the others who through social media are remarking about how their legs hurt after walking 4 miles or how they picked up some more bug spray for their journey tomorrow, this is a new adventure.

Interested in more? There's already another virtual game going on around town and the refuge. Celebrating the 75<sup>th</sup> anniversary, visitors to the Refuge in 2016 are encouraged to pick up a "75 Things Checklist" and see how many of the activities on the list they can do while here. Finish 25 activities or more to receive a limited-edition commemorative gift. Finish more to

compete for a grand prize. Visit the PokéStop at the refuge sign on Ski Hill Road and figure out what federal agency the quote that shows up at the stop really belongs to (hint: it is not the U.S. Fish and Wildlife Service) then come in to the Refuge Visitor Center for an extra stamp on your checklist.

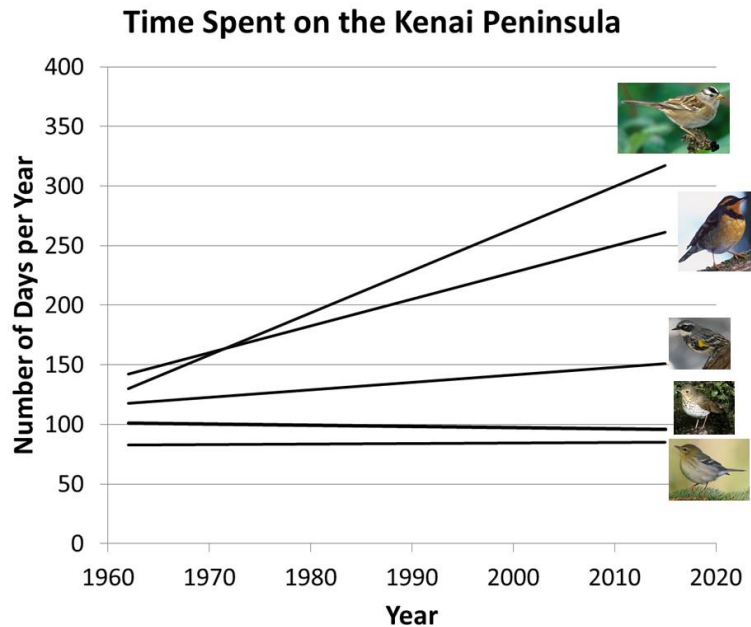
*Leah Eskelin is a Visitor Services Park Ranger at the Kenai National Wildlife Refuge. You can find more information about the Refuge at <http://www.fws.gov/refuge/kenai/> or <http://www.facebook.com/kenainationalwildliferefuge>.*

Heading out to play Pokémon Go this week? That's great! The Kenai Refuge Visitor Center in Soldotna is open seven days a week all summer long and staff can help you with trail information, tips on how to enjoy the outdoors safely, and even wildlife (the IRL kind) and plant identification lists to expand your adventure beyond the Pokédex. Rangers are also available through Facebook (<http://www.facebook.com/kenainationalwildliferefuge>) if you need trail help while out and about.

Just remember, virtual animal sightings are a bit different than live wildlife sightings. Always be aware of your surroundings, stay on marked trails, avoid getting close to any animals you do see, and unlike lure modules and incense in the game, baiting wildlife in for a closer look isn't permitted on the Refuge. Never feed wild animals, for their health and your safety.

# How flexible is migration timing for Kenai birds?

by Dawn Robin Magness



ebird and other records from local birders suggest that the migration window of Swainson's Thrush and Blackpoll Warblers is hard-wired. In contrast, some White-crowned Sparrows and Varied have become year-round residents, increasing their stay on the Kenai Peninsula by 150–200 days since the 1960s. Yellow-rumped Warblers arrive at the same time, but stay 41 days longer in the fall (photo credits: D. Menke (Varied Thrush), F. Miles (Yellow-rumped Warbler), B. Dyer (Swainson's Thrush), L. Karney (White-crowned Sparrow), D. Dewhurst (Blackpoll Warbler).

Our early spring, sunny days, and warm temperatures this summer changed my behavior. I considered planting my garden early, but my fear of frost overrode that instinct. I wore shorts and spent more time swimming in lakes. And I've been thinking about how birds may have changed what they did this summer.

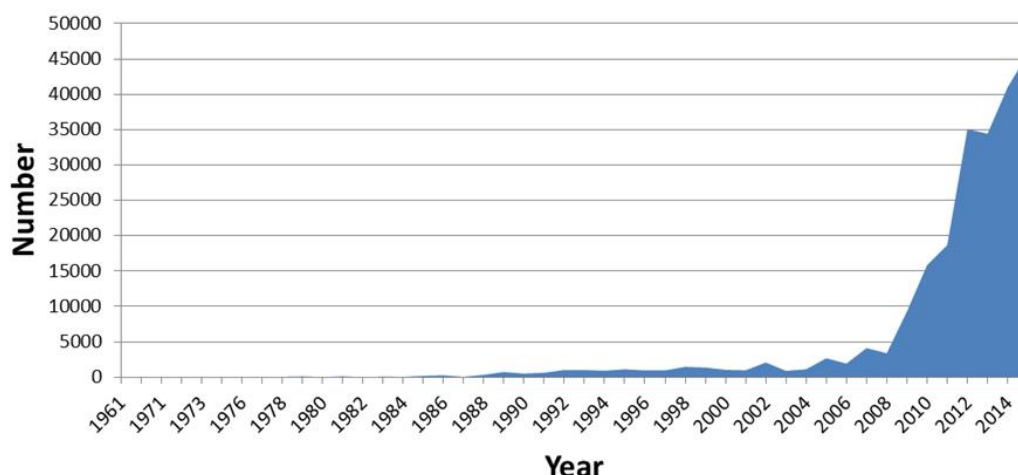
Many of our songbirds winter as far away as South America. I wonder if and how these summer migrants take advantage of the longer growing season and warmer temperatures that we've seen on the Kenai Peninsula the last few decades. There is evidence worldwide that some bird species are arriving on their breeding grounds earlier, nesting earlier, and wintering further to the north. Local birders and refuge staff have also noted new species overwintering, earlier arrivals of migrants and later departures from the Kenai Peninsula.

I wanted to take a closer look to see if some bird

species are shifting the time they spend here more than other species. In his well-researched book *The Avian Migrant: The Biology of Bird Migration*, Dr. John Rappole notes there is a continuum of birds from facultative migrants to obligate migrants. Facultative migrants are more flexible and move in response to conditions.

In contrast, obligate migrants are genetically hard-wired to migrate at certain times. Obligate migrants are generally, but not always, long distance migrants. This type of hard-wired migration timing would develop when seasonal patterns are very predictable because individuals that consistently got the timing right, using cues such as day length, are more likely to pass their genes to the next generation. However, because day length will not change as climate changes, these bird species may be less likely to take advantage of longer growing seasons.

## eBird Records for the Kenai Peninsula



*Bird observations recorded in an online database (<http://www.ebird.org>) for the Kenai Peninsula have increased dramatically in recent years (credit: D. Magness).*

I began to explore which birds on the Kenai have rigid or flexible migration timing using eBird data. eBird is a website (<http://www.ebird.org>) that networks observations of recreational and professional birders. Though the website was launched in 2002 by the Cornell Lab of Ornithology and the National Audubon Society, the first bird observations included in eBird date back to 1961 for the Kenai Peninsula.

However, observations are sparse until 2008 when local birders began to extensively use the online checklist program. I cannot adequately thank the birders who populate eBird for the information they provide. When enough people consistently add data, and enough species are observed on enough days throughout the year, then we can construct arrival and departure dates.

Thanks to Mrs. Mary A Smith (later Mary Miller), I was able to extend our understanding of arrival and departure dates to the 1960s. Smith was an avid birder who lived in Coho, right here on the Kenai Peninsula. I became aware of Mrs. Smith because her daily bird checklists were used to develop a bird checklist for the Kenai National Wildlife Refuge (formally the Kenai National Moose Range) in 1968.

A quick search online revealed that Smith was a very good birder who even co-authored scientific papers about birds on the Kenai Peninsula. Todd Eskelein, a birder and biologist at the Refuge, shared photocopies of a checklist notebook from 1961 and 1962. Although some species are not well represented because

they do not occur where she lived, Mary Smith's dedication to completing a checklist each day provides a good estimate of when birds arrived and departed Coho.

Using this information, I did see a continuum in how much different Kenai bird species have shifted the amount of time they spend here. Some species, like the Swainson's Thrush and Blackpoll Warbler, are arriving and departing at nearly the same time as in the 1960s. Both are long-distance migrants. Swainson's Thrush breed in the boreal forest and winter in southern Mexico and Central America. Blackpoll Warblers migrate from Alaska to northeastern South America.

In contrast, other species have shifted to spend more time here. White-crowned Sparrows seem to overwinter now, extending the time this species are observed here by 200 days! Varied Thrush are spending on average 145 more days on the Kenai Peninsula and overwintered in Seward and Homer in 2013 and 2014. A paper published in 1965 in the *The Condor* reported that a few White-crowned Sparrows were seen at feeders in Anchorage in the 1960s, but not on the Kenai Peninsula. Varied Thrush were not documented anywhere in Alaska during winters at that time.

Both White-crowned Sparrows and Varied Thrush are shorter distance migrants. White-crowned Sparrows winter in the Lower 48 and Varied Thrush winter mainly in California. Seeing these birds in the winter does not give insight into whether individual of either species are now full-time residents or if these are indi-



viduals that breed further north and now winter here.

Yellow-rumped Warblers breed in the boreal forest and winter along coastlines of the U.S. and in Mexico. Interestingly, these warblers arrive at the same time as they did in the 1960s, but are staying 41 extra days in the fall.

At this point, I have more questions than answers about if and how birds are changing. It is not clear if species with rigid migration timing, like the Swainson's Thrush and Blackpoll Warbler, are less successful because they have not arrived and nested earlier

as the growing season becomes extended in Alaska. I also wonder if birds that arrive early and depart late are unique or the norm for the species. This is why science is fun—one question invariably leads to another.

*Dr. Dawn Robin Magness is a Landscape Ecologist at the Kenai National Wildlife Refuge. Readers who have stories about Mrs. Mary Smith are welcome to contact me (260-2814). Find more information about the Refuge at <http://www.fws.gov/refuge/kenai/> or <http://www.facebook.com/kenainationalwildliferefuge>.*

## The first step in solving invasive species problems

by Joel Stone



*Adam Reimer (ADF&G) applies Rotenone, a chemical used to eradicate northern pike from wetlands surrounding Soldotna Creek (credit: Gayle Nuefeld, ADF&G).*

Invasive species are a great concern the world over. An invasive species is one that is not native to an area, and potentially disrupts or damages native species populations. Northern pike, for example, are native in waters north of the Alaskan Range but, in southcentral Alaska, they are considered an invasive species. Introduced illegally into waters of the Kenai Peninsula by people presumably looking for more sport fishing opportunities, pike have become a problem by drastically reducing trout and salmon populations in many areas. So the Alaska Department of Fish and Game (ADF&G) has begun taking steps to deal with this species.

As a biological intern with the Kenai National

Wildlife Refuge, I was assigned to be a field grunt for a week to help ADF&G eradicate pike from the Soldotna Creek watershed. Many native fish in the creek are being temporarily held captive while Rotenone, a compound derived from tropical plants in the bean family, was applied to kill pike. Rotenone is a very effective chemical that targets the cellular respiration process in gilled organisms while remaining relatively harmless to mammals and birds at the concentrations used for fish control.

Drip stations (that meter out Rotenone) were established along the mainstem of Soldotna Creek while a helicopter sprayed more inaccessible wetlands. Two- and three-person crews with backpack



sprayers treated any stagnant water that could have been missed. One-pound Rotenone mixture balls were used to treat smaller tributaries. A treatment station added potassium permanganate at the mouth of Soldotna Creek to neutralize Rotenone before it entered the Kenai River so as not to affect returning salmon. Rob Massengill, ADF&G project coordinator, contacted landowners surrounding the creek beforehand and they overwhelmingly supported the project.



*Joel Stone, a biological intern at Kenai National Wildlife Refuge, pulls bird vetch growing on private lands in a coordinated effort to eradicate this invasive plant from the Kenai Peninsula.*

On Day 1 of the five-day project we were briefed on what was to be done, grabbed our personal protective equipment, prepared our packs and then headed out. Once we arrived at our location and put on our PPE, it became more than obvious that it was going to be a long day. Cooking like fish on a fire, we fought our way through the day, seconds turning into minutes, minutes to hours and eventually we hit our home stretch. In those moments, many of us hated that we signed up for this project but deep down were proud. We were taking steps in solving a serious problem.

Invasive species, whether plant, animal or fungus, can cause serious problems. These species can out-compete native species or prey upon them. Salmon, for example, play a very key role in the lives of many predators, including some humans. Beginning to deal with the pike problem allows for these species (and us!) to continue to thrive and succeed.

Meadow hawkweed is another invasive species I have the honor of helping eradicate. This hawkweed is a perennial herb native to Europe. It grows in dense fields that decrease native plant diversity and can cause issues for animals that would normally graze there. Because of impacts this weed can have on our ecosystems, it was deemed necessary to begin taking steps towards eradicating it from the Swanson River Oil Field within the Kenai Refuge. Searching through the area with our backpack sprayers, we joined two private contractors in tackling this problem, slowly beginning to destroy hawkweed on roads, pipeline corridors and well pads.

In Cooper Landing, another invasive plant had taken root by the post office and was fast on track to spread to nearby Kenai Lake and the Kenai River. White sweet clover, a species native to Eurasia, seems to have recently infested the post office grounds so I and other Refuge interns headed out there to get our hands dirty. We spent a day-and-a-half pulling all the clover, hopefully before it went to seed. It'll need to be checked next summer to ensure it was eradicated from the area.

Last summer, herbicide treatments to elodea, an extremely invasive and injurious aquatic plant, were completed in three lakes north of Nikiski by partners in the Kenai Peninsula Cooperative Weed Management Area. Almost immediately after elodea was discovered in late 2012, steps were put into action to stop it. I've already participated in multiple surveys this summer that have yet to find any elodea in the treated lakes or in any other lakes on the peninsula.

I've learned that attitude counts in managing invasive species. There needs to be a willingness to do what you have to do to make them go away. When a species first arrives it might not cause issues but, without proactively dealing with it, it is enabled and allowed to perpetuate to a state that may be irreversible (certainly without great expense). People say the first step to solving a problem is admitting you have one. With invasives, the next step that follows soon after should involve getting your hands dirty.

*Joel Stone is a biological intern at Kenai National Wildlife Refuge. He is an undergraduate student at the University of Alaska Fairbanks, majoring in Wildlife Biology. Find more information at <http://www.fws.gov/refuge/kenai/> or <http://www.facebook.com/kenainationalwildliferefuge>.*



## What puts the “smart” in Water Smartweed?

by Mariah McInnis



*Water smartweed (Polygonum amphibium) on Daniels Lake*

It was a beautiful sunny day and we were well into surveying for the hybrid Elodea on Daniels Lake. The sun was beating down on us and I suddenly realized that it is indeed possible to get sunburn in Alaska. Elodea is an invasive waterweed and we were hoping that previous efforts to eradicate it were successful and that we would not be detecting any on our sampling rakes. After pulling up an array of native aquatic plants but no Elodea most of the day, we were confident that it wouldn't be showing up anytime soon.

Being a Florida native, Alaska sunburns aren't the only thing I'm not used to. There are many plants that

I'm not used to seeing here on the peninsula. One of these plants is the water smartweed (*Polygonum amphibium*) which caught my eye as our boat rounded a corner. It's pretty recognizable with its bright pink buds that shoot up on a stalk a few inches from the water's surface. There were so many that this area of the lake appeared dotted with pink.

But this plant is more than just a pretty sight—it's incredibly interesting and serves many different functions. Not only is it native to Alaska, but this plant is found almost everywhere across the U.S. except for my home state of Florida, Georgia, Alabama and, not

surprisingly, Hawaii. It's also native to Asia, Europe, and parts of Africa.

As you can tell from its extensive range, *Polygonum* is a large and variable genus of around 65–250 species, depending on how taxonomists classify it. Common names for this genus include knotweed, knotgrass, tear thumb, and of course, smartweed. The genus name is from the Greek word *poly* for “many” and *gonu* meaning “knee” or “joint” in reference to the swollen jointed stem.

More recently it has been split into more natural segregate genera with the smartweed belonging to *Persicaria*, along with 100 other *Polygonum* species with similar flower structures. The name *Persicaria* means “little peach” in Latin, named for the resemblance of the leaves of many species in this genus to those of little peaches.

The perennial water smartweed commonly grows semi-submerged in shallow water. The oval or short-cylindrical spikes of pink flowers and the floating elliptic or oblong leaves distinguish it from the closely related marsh smartweed (*Polygonum muhlenbergii*). They are typically found in fresh, moderately acidic or mildly alkaline water. Although they enjoy shallow water, they can continue to grow with very little moisture.

Plants may have bisexual or unisexual flowers, with some plants bearing only male or only female flowers. There is also a terrestrial form of the smartweed which is quite different in general appearance to the aquatic version. This trait explains “amphibious” in the full species name *P. amphibium*.

The smartweed has a long history of being used by humans. Plains Native American tribes used the species as a food source while others used the roots, stems and leaves medicinally. Many species under *Polygonum* are also used in a variety of Chinese

medicines as well. Some species are thought to have antibacterial and antifungal properties as well as being an antioxidant.

When I first heard the name smartweed I immediately was curious about what made the weed so ‘smart’. Funnily enough, it has nothing to do with intelligence. The name apparently comes from the original word “arsmart” for the use of the plant in medieval times to relieve itching and swelling of the human posterior. I didn’t see that coming!

Not only have humans used the smartweed as a food source but they are also an excellent food source for waterfowl, particularly game ducks, of which Alaska has plenty! The small, pink seeds are the main part of the plant that is usually consumed.

In more recent years, scientists in England have found that the water smartweeds growing in old gold mine tailings can accumulate trace amounts of gold into their tissues at levels significantly higher than expected from background levels. Some have suggested that the plant could be used as a bioassay of useful minerals or to clean up badly polluted sites. *Polygonum amphibium*, in particular, is a good accumulator of phosphorous and nitrogen.

After all my research I felt genuinely surprised—I would have never guessed that this pink-budded waterweed could prove to be such an interesting plant with such a rich history. Who knows, maybe we’ll be seeing the smartweed being used in the future to help mitigate the effects of pollution. Now that would be smart!

*Mariah McInnis is a biological intern at Kenai National Wildlife Refuge. She recently graduated from Florida State University, majoring in Environmental Studies. Find more information at <http://www.fws.gov/refuge/kenai/> or <http://www.facebook.com/kenainationalwildliferefuge>.*



# Adventuring with the Student Conservation Association

by Brad Stoner



*Brad Stoner, in his 4<sup>th</sup> internship with the Student Conservation Association, describes a stickleback to 4<sup>th</sup> and 5<sup>th</sup> graders at Headquarters Lake as part of the Get out & Get Dirty summer camp at Kenai National Wildlife Refuge.*

I grew up in a small suburb of Los Angeles California. Then again, small is a relative term seeing as my home town of La Canada, California, has over 20,000 residents whereas Kenai and Soldotna combined are less than half of that population.

For as long as I can remember I wanted out of that crowded place. I decided to go to a smaller college where I got my B.S. in Criminal Justice with a minor in Environmental Studies. I choose that field of study only because I thought it would be interesting and I

had no real plans for a job.

That's when I found the Student Conservation Association or SCA. The SCA is an organization focused on introducing people of a variety of ages and backgrounds to the conservation career path through working as a volunteer at Federal agencies. Through the SCA you are exposed to career options you may never have known existed.

I first served with the SCA in Wisconsin at Horicon National Wildlife Refuge (NWR). This was the first



time I ever lived completely alone. In fact, at night, there was nobody else ever closer than a mile. The stars, the nature sounds, and the thousands of fireflies took my breath away. During this position I had the opportunity to ride an airboat for the first time—it was absolutely amazing! I spent the evenings fishing for northern pike and my days were filled either running the visitor center or roving the trails and interacting with visitors. I've been hooked on the SCA ever since.

The following summer, I returned to the Midwest as an SCA intern, but this time I was stationed at Big Stone NWR on the border between Minnesota and South Dakota. As a Biological Technician, I helped conduct waterfowl surveys, and banded Canada Geese and Mourning Doves. Having grown up in a city, I had never before used a weed whacker or a mower and now I was given the opportunity to use both. I also learned how to tow and back up a trailer. And ever since I was little I have always wanted to ride in a fire truck and use the hose to put out a fire and at this position my dream came true...sort of. I used the fire hose to clean out the Refuge's pit toilets, but close enough.

I graduated from college in 2015 but still had not figured out what I wanted to do—the SCA was my answer once more. For 14 weeks as a Park Ranger at Sevilleta NWR in New Mexico I provided education programs to 4<sup>th</sup> grade classrooms twice a week in Albuquerque.

While there, a former contact at the SCA got me to apply for my current 12-week position here on the Kenai Peninsula, one of the most beautiful locations I have ever seen. During this summer, I'm back in an environmental educator role and have enjoyed spending the summer assisting with the summer camps hosted by the Refuge.

The SCA has not only helped shape my career path but the paths of hundreds, if not thousands, of both former and current interns serving for this wonderful organization. While I may not have my whole future planned out, I know I'll be in Homer for the next year. My concern that my time in Alaska would be painfully short was alleviated by my good fortune to obtain a 52-week internship at Alaska Maritime NWR, my fifth SCA position.

So, if you ever find yourself down in Homer, stop by the Alaska Islands and Oceans Visitor Center and say 'hi' to Ranger Brad. I would love to share more about my adventures and the SCA program (<http://www.thesca.org/>).

*Brad Stoner graduated from California Lutheran University in Thousand Oaks, CA. Prior to Alaska, Brad worked in Wisconsin, Minnesota, Illinois, California and New Mexico. Find more information about Kenai Refuge at <http://www.fws.gov/refuge/kenai/> or <http://www.facebook.com/kenainationalwildliferefuge>.*

# Options for managing wildfires in Alaska

by Nate Perrine



*The 2009 Shanta Creek Fire, located in Congressionally-designated Wilderness on the Kenai National Wildlife Refuge, was managed as a natural ecosystem process.*

Over 100 years ago, our nation adopted its first policies about dealing with wildfires. A gigantic forest fire in Idaho, which burned 3 million acres, was the main reason the topic was brought up. People as far away as Watertown, New York, were affected with smoke and ash fallout. The sun was obscured by smoke, and some people were having difficulty breathing. The charred landscape looked devastating, every bit of green now black and dead. The public outcry was the catalyst for creating a new strategy of aggressively fighting every wildfire. Forest fires were now

considered to be the enemy, and must be stopped.

These early policies stated that every fire must be controlled by 10 am the next day after being found. The newly-funded U.S. Forest Service took the lead as the main agency tasked with the job. Soon after, the first Smokejumper and Hotshot crews were created. These were elite firefighters who were organized similarly to the military.

Back in the early days, there were also some not so elite firefighters. When large fires burned, it was not uncommon for a forest ranger to visit the local

bar and recruit on-the-spot anyone who could meet at least three criteria to join the fight—they needed a pulse, they needed to be sober enough to stand on their own, and they wanted to join the fight.

In the West in particular, almost everyone had a role to play when fires burned. We also evolved as a nation and invested in new technologies. We learned from experience the right and wrong things to do to control fires. It didn't take very long before the U.S. had arguably the best wildfire fighting force in the world. As Americans, that's just how we like to do things!

The only problem was we got a little too good at it. Although it was well intended, putting out natural wildfires had unforeseen consequences. We inadvertently created forests that, due to the suppression of naturally-ignited fires, became un-naturally overgrown, dense, and ultra-flammable. Periodic, low-intensity fires had been replaced by gigantic "megafires". Old timers used to say that back in the 1960s a 10,000-acre wildfire was considered huge in the Lower 48. Nowadays, that's chump change.

It's not that we regressed as a firefighting force, but because the conditions we face today are vastly more complicated. Forests are more flammable, urban areas are encroaching further into fire prone areas, invasive plants have changed fire regimes, and climate change is likely responsible for longer fire seasons and creating the extreme weather conditions needed for these giant fires to occur. It is a mixture of factors that have created our current situation and there are no easy answers of how to properly address them.

In Alaska, we face the same challenges seen everywhere else—how can we balance maintaining healthy ecosystems and still be able to safely live within them?

Alaska has a statewide fire management plan that

defines options for the initial response to new wildfires. These management options range from areas where fires are aggressively suppressed, mostly in populated areas, to places where they may be left to burn on their own. Many fires in the Alaska Interior are managed by protecting values at risk, such as native allotments and structures, while not trying to stop the fire itself. This tactic has left most of Alaska in far better shape ecologically than much of the Lower 48.

Here on the Kenai, there are several vegetation treatment projects both planned and implemented collaboratively among agencies designed to help to protect communities from wildfire. These are mostly strategically-placed forest thinning projects which create a buffer zone from a raging wildfire.

The Funny River Fire from 2014 is a prime example of how these projects help firefighters control fires in areas where they are dangerous. A previously-thinned area along Funny River Road was used as a control line when that fire was bearing down on Soldotna. It was a real life study which proved the worthiness of creating these areas. The effectiveness of these treatments is greatly enhanced when homeowners also "Firewise", or reduce flammable vegetation around their homes and property.

Wildfires are inevitable, and the longer a forest goes without having natural fires, the worse it can be when a fire does happen. It's sort of like being in debt and only paying the minimum payment. It may feel good to kick the can down the road, but it eventually catches up and ends up costing you more in the long run.

*Nathan Perrine is the Fire Operations/Fuels Technician at Kenai National Wildlife Refuge. Find more information at <http://www.fws.gov/refuge/kenai/> or <http://www.facebook.com/kenainationalwildliferefuge>.*



# Pushing away from single use plastic water bottles

by Marcos Anguiano

Plastic water bottles have been around since the 1940s helping humans transport fresh, clean water. During Roman times, aqueducts were built to provide water to cities, and animal skins were used to transport water from place to place. Clay and woven materials were molded into water carrying devices so the skin would have support and also to be easier to transport. Since then portable water has always been in high demand.

When plastic water bottles were introduced to the public, consumers and manufacturers quickly accepted the idea because they were light weight, had low production costs, and were a better choice than glass bottles. Besides wine and beer, almost the entire food industry made the transition over to plastic because it was cheaper to make in large quantities.

Bottled water is advertised as a product that holds pristine water from mountain springs intended for everyone who cannot reach those springs. It is easy to go to the store and stock up with water bottles because they are so inexpensive, but something that is not so transparent is the environmental footprint that was made to get the water bottle there.

Long before we pick up a bottle from the grocery shelf, the plastic needs to be manufactured from petroleum hydrocarbons, the bottles and caps molded from the plastic, and then the bottles filled with “pristine” mountain water before packaging them and transporting them off all over the world. The irony is that it takes three times more water to produce a plastic bottle than it does to fill it!

And while it’s a great idea to produce portable water, what to do with all those plastic bottles? Consider that Americans use 50 billion plastic water bottles annually, but only 1 in 5 bottles are actually recycled. That leaves a LOT of bottles going to the landfill or perhaps ending up as marine debris in the Great Pacific Garbage Patch or on our beaches as sand-like plastic grains.

The National Park Service has taken action and has banned the sale of single use water bottles in their souvenir stores and visitor centers since 2011. The 19 Na-

tional Parks that made this commitment have gradually seen a change in visitor and vendor behaviors. Affordable reusable water bottles are available for sale in their visitor centers and souvenir shops, and water filling stations are available on site that actually provide local spring water in some cases. Now is the time to educate visitors on ways to reduce their carbon footprint in order to help preserve the parks for future generations.

We’ve taken that first step here at the Kenai National Wildlife Refuge. Re-usable water bottles are provided to kids at the Critter Camp and Get Out & Get Dirty Camp to help instill the ethic that reducing consumption is important. Our campers also have to navigate the water bottles as obstacles on the balance beam during our Animal Olympics.

Going a step further to help reduce the waste of disposable bottles, the Refuge has installed a refill station in our new Visitor Center and one in the old Headquarters for both visitors and staff to use. Please use them! Alaska Geographic sells aluminum water bottles through our Visitor Center.

Refuge staff also recycle plastic #1 and #2, along with glass and aluminum cans, at the Central Peninsula Landfill. Plastic #1, also known as polyethylene terephthalate (PET), is typically used to make single use water bottles, but also containers for soft drinks, juice, mouthwash, sports drinks, ketchup, salad dressing, jelly and jam. Plastic #2, also known as high density polyethylene (HDPE), is often used for bottles to hold milk, water, juice, cleaning supplies and shampoo, and to make recyclable grocery bags.

The Kenai Refuge is helping keep plastic out of where it does not belong through education, refill stations, and recycling. Reduce, Reuse and Recycle!

*Marcos Anguiano is a Student Conservation Association intern, working with Visitor Services at the Kenai National Wildlife Refuge. He is an undergraduate student at Sacramento State University. Find more information at <http://www.fws.gov/refuge/kenai/> or <http://www.facebook.com/kenainationalwildliferefuge>.*

## Versatility in the game of climate change

by Todd Eskelin



*This Mourning Cloak was visiting tires at the Kenai National Wildlife Refuge headquarters on 8/24/2016. It may be licking mineral salts picked up from roads (credit: Todd Eskelin USFWS).*

September 19 was one of the first frosty mornings of the fall last year and I had moose calls on the brain. Deep in the woods I was grunting and groaning with the best of them, trying to entice a very large (or very small) moose into my bow's range. Things were going well except there were zero animals in the area that I was audibly abusing with my poor moose imitation. As the sun rose and my chances of finding anything were dashed by 60 degree weather, I noticed a colorful butterfly flitting around my camo-covered legs.

I recognized the butterfly as a Mourning Cloak

and wondered what it was doing out so late in the year. There were no flowers blooming and no apparent food source. Perhaps another victim of climate warming? I guessed it emerged late in the summer and was bound to die soon as temperatures dropped below freezing. For many critters requiring orchestrated timing for their lifecycles, a changing climate can often disrupt the timing of critical events and result in a quick demise. In this case, I hadn't seen this butterfly during the height of summer so I investigated further.

There is an emerging field of study on how climate change leads to shifting phenology. In some cases, species that are obligates to a migration route or seasonal window may be unable to shift. So they arrive at their destination to find that the critical hatch of insects, a spawning fish, or blooming of a particular plant happened two weeks early and now they are out of luck. For species locked into a particular path, this can lead to complete reproductive failure and, possibly, even extinction. This phenological mismatch is described in an article by Visser and Both in 2005 (<http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1559974/>).

It turns out what I was seeing was completely normal. Mourning Cloaks are one of the longest lived butterflies in their adult stage. They often survive as adults for up to 10 months, which is an eternity for butterflies. They overwinter as adults in any little nook or cranny to protect them from harsh winter temperatures and moisture. Hidden away, they enter a period of frozen stasis called cryopreservation. As soon as temperatures rise in the spring they come out of stasis, typically May but as early as the March thaws we've had in recent years. The males sun themselves on the ground or on a twig trying to attract females. A brief aerial courtship ensues and mating occurs. After mating, the eggs are laid on deciduous twigs like willow, aspen, cottonwood or birch. Adult Mourning Cloaks die shortly after breeding and laying eggs.

An interesting [article](#) by Mikaela Huntzinger in 2003 in *Biological Conservation* describes the positive effects that shaded fuel breaks and other fire management practices have on butterflies. Presumably, opening the canopy allows more sun and the proliferation of hardwoods following canopy thinning provides egg laying substrate. The forest clearing by fire managers along Funny River Road and more recently in Sterling may have collateral benefits for some butterflies.

The caterpillars hatch and as a group consume greenery from their host deciduous tree or shrub until

they are fully grown. They then disperse from their host tree and pupate in June or July. After a short period, Mourning Cloaks emerge as adults but then aestivate (a kind of hibernation) in mid-summer, protecting them from extreme warm or dry conditions—thus the reason I had not been seeing any during the summer months. When temperatures cool in the fall, the adults seek out food to store for their long winter stasis period.

With nectar in short supply during this period, Mourning Cloaks fuel up on tree sap and decaying berries, storing energy needed to overwinter and for the post-emergence period in early spring when food is scarce. They will often be found when there are still patches of snow on the ground.

So my initial guess that the butterfly I saw flitting around on that late fall day was a goner was completely wrong. The Mourning Cloak may be one of the most versatile and resilient butterflies to climate change that we have. Being able to go into stasis during the cold of winter and heat of summer as an adult allows it the flexibility to respond to wide climate and weather fluctuations. And there is nothing critical about the timing of its emergence. All it needs is to have mild temperatures in the spring and fall. It is not specialized to one habitat, but survives from northern Alaska to Mexico. It requires no specific plant host, just some common deciduous woody plants.

While there are many valid concerns over migratory birds or insects that may be impacted greatly by global warming, the Mourning Cloak appears to be off that list of vulnerable species for now—this butterfly species is among the least of our worries.

*Todd Eskelin is a Wildlife Biologist at the Kenai National Wildlife Refuge who specializes in subsistence harvest and birds. Find more information at <http://www.fws.gov/refuge/kenai/> or <http://www.facebook.com/kenainationalwildliferefuge>.*



# Invasive plants: Planning today for the future of tomorrow

by Mariah McInnis



*Strands of Elodea spew out of the Eyak Lake spillway in Cordova during March 2015. Rapid management response to early detection of Elodea in Stormy and Daniels Lakes makes this an unlikely future scenario on the Kenai Peninsula (credit: J. Morton).*

Earlier this month I was fortunate enough to take part in the course “Field Techniques for Invasive Plant Management” taught by instructors from the National Conservation Training Center in Shepherdstown, West Virginia. The course was packed full of experienced speakers, PowerPoint presentations, interactive activities and hands-on demonstrations. This course was a dream for someone like me who has very little experience when it comes to invasive plant management. In fact, the little I did know about invasives came from my short time here at the Kenai National Wildlife Refuge where I spent some long days learning first-hand about White Sweet Clover, Bird Vetch,

and Elodea.

Invasive plants are introduced by vectors such as cars, people, planes, boats, “dirty” straw, or the commercial trade in ornamental and aquarium plants. Once established, many invasive plants have the ability to negatively impact the natural ecosystem and resources within and around it. It doesn’t take much for infestations to get started and then spread, which is why early detection is so crucial to keeping things in check.

Early Detection Rapid Response (EDRR) is an approach that refers to finding and responding to a new infestation of invasive weeds as soon as possible, be-

fore they grow out of control. This was an underlying theme of this training course throughout the week. One of the course's case studies was how a local group tackled Elodea, a hybrid between Nuttall's and Canadian Waterweed, right here on the Kenai Peninsula using EDRR. Elodea was first found in Stormy and Daniels lakes and, within only a few short months of identifying it, action was taken with the end goal of eradication.

Elodea is an aquatic plant and is especially harmful because it has the ability to negatively alter salmon habitat. It also does not rely on a seed bank and instead reproduces asexually. This means that only a single strand of Elodea has the ability to replicate itself and take over an entire lake. Because of efforts here by the Kenai Refuge and its partners to implement EDRR, Elodea is currently thought to be eradicated after chemical treatments in 2014 and 2015.

Of course, early detection cannot be executed without substantial communication and collaboration. This theme was further reinforced by the course itself which allowed folks from all over the country to come together to discuss how to get ahead on the war against invasive plants. There were many discussions about what was working and what wasn't, and how to best conquer the specific problems people were having in their respective areas. Exchanging ideas and protocols gave people the chance to create a successful game plan and bring that knowledge back with them upon returning home.

There were people from different states but a large majority came from different areas of Alaska. The conflict with invasive plants is especially important here because we have the rare opportunity to learn from the mistakes of the Lower 48 while we still have the upper hand. Alaska's geographic position in the northern

latitudes and lack of an extensive road system help to reduce the introduction and spread of invasive plants. Unfortunately, what we lack in roads is made up for by a large population of planes and float planes that can act as vectors to transport invasive plants to remote areas of the state. Again, education is crucial because this problem can be easily solved when pilots understand the risk and take the extra time to ensure their planes are clean and free of plant material before taking off. If everyone is on the same page we can stay one step ahead.

Alaska is already doing a great job at continuing education and informing the public. In fact, there is an upcoming invasive species workshop scheduled for October 25–27, 2016 in the City of Fairbanks at the Wedgewood Resort. This is another great opportunity for professionals to collaborate and connect.

Wondering how you can help as a citizen? Downloading the Alaska Weed ID app on your cell phone allows you to identify weeds in your area and submit your observations. The more that people keep an eye out the better our chances at catching infestations early on!

Alaska's vast and beautiful wilderness is a trademark of this state and the reason many come to call it home. The threat of invasives has already begun but with proper education, early detection, and rapid response we have the ability to halt invasives in their path. If we don't, we risk altering the natural landscape we've all come to love.

*Mariah McInnis is a biological intern at Kenai National Wildlife Refuge. She recently graduated from Florida State University, majoring in Environmental Studies. Find more information at <http://www.fws.gov/refuge/kenai/> or <http://www.facebook.com/kenainationalwildliferefuge>.*



# Where salmon streams get their water matters

by John Morton



*Sheep Creek, which receives meltwater from Dinglestadt Glacier that straddles the boundary between Kenai National Wildlife Refuge and Kenai Fjords National Park, should sustain good salmon habitat regardless of warming air temperatures.*

Did you know that the Kenai Peninsula has 1,800 miles of anadromous streams and rivers that flow into our surrounding salt waters from 374 outlets? We are indeed blessed with an abundance of salmon, Dolly Varden and hooligan habitat.

But not all streams are created equally. Some are fed by meltwater from glaciers and persistent snow fields high in the Kenai Mountains. Certainly the largest example of a mostly glacial system is the Kenai River, the only river that receives water from both the Harding and Sargent Icefields in its upper watershed. Further downstream, it receives substantial nonglacial input from the Killey, Funny and Moose Rivers, all of which originate on the Kenai National Wildlife Refuge.

The largest nonglacial stream on the peninsula is the Anchor River, which presumably receives its inputs from precipitation, groundwater and surrounding

peatlands. A 2015 article published by Mike Gracz of the Kenai Watershed Forum sheds some light on what the relative contribution of those sources might be. Using two different methods, Gracz and his coauthors showed that 55 percent of dry season flow in Limpopo Creek, an Anchor River tributary, originated from adjacent peatlands. Peat stores water well and so buffers against dry seasons and drought.

Whether a stream originates from glacial or nonglacial sources has real implications for salmon. The source determines its vulnerability, and therefore salmon's vulnerability, to our rapidly warming climate. Since 1968, available water, which accounts for precipitation and evapotranspiration, has declined by 60 percent on the western Kenai Peninsula. Ed Berg, retired refuge ecologist, estimates that roughly one-third of the decline is due to increasing temperatures



and two-thirds due to decreasing precipitation.

For non-glacial streams, increasing air temperatures is a big deal. It directly corresponds with water temperatures. Sue Mauger, with the Cook Inlet Keeper, found that 47 of 48 nonglacial streams she monitors on the Kenai Peninsula and Mat-Su experienced temperatures in July that cause sublethal stress in salmon. This past summer, she recorded the highest temperature in the Anchor River since 2002 on July 18<sup>th</sup>, reaching 70 degrees. On the Deshka River, water temperatures reached 77 degrees! Given that salmon spawning is impacted at 55 degrees, these temperatures don't bode well.

In contrast, glacially-fed rivers are robust against varying air temperatures. Water temperatures at the Kenai Lake outlet in Cooper Landing tend to hover in the low 50s in July. Robert Ruffner (Kenai Watershed Forum) says that lower Kenai River temperatures may exceed 60 degrees in July during short periods of calm weather, but will quickly drop again when winds pick up, presumably from mixing strata in Kenai and Skilak Lakes.

But more glacial meltwater is not necessarily a good thing. A long-term study by the Alaska Department of Fish & Game showed that sockeye recruitment in Skilak Lake was depressed by the additional input of glacial meltwater during the 1990s. More water, more silt, higher turbidity, reduced light penetration, reduced phytoplankton abundance, reduced copepod biomass and, finally, reduced salmon recruitment. What a complex web!

Although it's difficult to generalize, I suspect that nonglacial streams are more vulnerable than glacial streams to climate warming in the short term. Not only are air temperatures increasing rapidly, but shorter periods of ice cover mean extended periods for those waters to receive solar radiation. Also, spruce trees killed by spruce bark beetles gone amuck and thin-leaf alder defoliated by exotic green alder sawflies mean less canopy cover and more solar radiation.

And then the peatlands, which we have learned buffer nonglacial streams during dry seasons, are themselves drying. Berg has demonstrated that many of our *Sphagnum* peatlands, which have persisted on the Kenai landscape for more than 8,000 years, are being invaded by woody shrubs such as dwarf birch in

just the past 40 years. Wetlands in the Kenai Lowlands have lost 6–11 percent of their surface area per decade over the same period.

Glacially-fed streams, on the other hand, are good to go as long as our icefields persist. Given that the Harding Icefield may be as deep as a mile, we've got time. Nonetheless, the Harding Icefield has shrunk more than 60 feet in average elevation since the 1950s, and estimates of lost surface area have been recently revised from 5 percent to 11 percent over that same period. While scrutinizing Google Earth, I noticed many short, high-gradient mountain streams flowing into Resurrection Bay that originated from snow fields or glaciers in satellite imagery taken 3 decades ago, now appear to be discontinuous from anything white during the summer months.

So what to do other than wring our hands? Mauger uses thermal imagery to identify areas with cold seeps in the Anchor River that the Kachemak Heritage Land Trust then purchases to retain a source of "refrigeration" in those warming waters. Restoring and maintaining riparian vegetation is also an easy way of providing shade to reduce solar input into streams.

A less obvious but smart solution to changing environmental conditions is to maintain high genetic diversity in our salmon populations. As the focus in recent years has been on sustaining high harvest levels, there is pressure to enhance our fisheries with hatchery-raised fish. While there is nothing inherently wrong with the practice of "ranching" salmon, it can become a problem if we ignore the fate of small native salmon stocks in our smaller streams (like Slikok Creek) because overall escapement goals are being reached. As in farming, it's not wise to grow your crops as a monoculture.

The bottom line is that sustaining salmon on the Kenai Peninsula in a rapidly warming climate will not be accomplished by tried-and-true management practices of the past. We're going to need creative solutions to this wicked problem.

*John Morton is the supervisory biologist at Kenai National Wildlife Refuge. You can find more information about the refuge at <http://kenai.fws.gov> or <http://www.facebook.com/kenainationalwildliferefuge>.*

## Celebrate Kenai National Wildlife Refuge's 75<sup>th</sup> Birthday through a Very Special Event!

by Amber Kraxberger-Linson and Candace Ward



*Jim Pfitzer re-enacts the life of conservationist, Aldo Leopold, in a free one act play A Standard of Change, Friday evening, October 8, at the Kenai Chamber of Commerce Visitor Center. (Photo from Jim Pfitzer's website).*

Celebrate Kenai National Wildlife Refuge's 75<sup>th</sup> Birthday year with a grand opening art show event on Saturday evening, October 8, from 6 – 8 PM, at the Kenai Chamber of Commerce Visitor Center in Kenai, Alaska. This is a free event for the public and features spectacular photographic artwork and fascinating historical artifacts along with a guest artist entertainment presentation.

Tom Collopy and Mary Frische of Wild North Photography based in Homer, Alaska, spent over 4 years traveling the Refuge in all seasons capturing amazing photos of scenic vistas, wildlife, and visitors having fun. Using the power of photography, Mary and Tom work to create transcendent images that inspire viewers to appreciate the Refuge with a sense of awe and wonder. They work in a unique style done through printing photographic images on

stretched canvas then applying clear varnish brush strokes which give each image a painting-like quality that is exceptionally beautiful.

Other photographers who kindly provided images of the Refuge for the photographic art exhibit include Berkley Bedell, Karen & Kennan Ward, Michael Bernard, and the *Peninsula Clarion*.

To lend a sense of history to the event, Refuge staff led by Amber Kraxberger-Linson, Daniel Saxton, and Leah Eskelin rounded up Refuge artifacts from the last 75 years to display with the photographic art work. These items range from a hand carved rolling pin found at an historic Refuge cabin to original signs from the Kenai Moose Range era of 1941–1979. These items give a texture and dimensionality to the exhibit and connect people over time with the Refuge.

The reception includes delicious appetizer refresh-

ments sponsored by the National Wildlife Refuge Association. Each family attending the event also receives a free commemorative poster done in a colorful retro style of the 1940's illustrating a bull moose in water with a scenic mountain backdrop.



*View the photographic art of Tom Collopy & Mary Frische's adventures on Kenai NWR at the Kenai Chamber of Commerce Visitor Center from October 8 - November 20. (Photo by Tom Collopy)*

In addition, there will be a unique entertainment event. Guest artist, Jim Pfitzer, will portray conser-

vationist Aldo Leopold in the one-man one-act play *A Standard of Change*. The play takes place during one evening in the famous Wisconsin shack where Leopold was inspired to write his influential book, *A Sand County Almanac*.

Published after his death in 1949, *A Sand County Almanac*, captured Aldo Leopold's life-time of natural history observation and wildlife management philosophy. Leopold was a professional member of the Boone and Crockett Club, the Co-Founder of The Wilderness Society, and a Professor of Game Management at the University of Wisconsin-Madison. He believed that we can be only ethical to the land "in relation to something we can see, feel, understand, love, or otherwise have faith in."

For those who appreciate and love the land and wild community that is Kenai National Wildlife Refuge, please join us for a wonderful evening celebrating our Refuge as a very special place for the last 75 years in all of our lives.

*Amber Kraxberger-Linson and Candace Ward are park rangers in the Visitor Services Program at Kenai National Wildlife Refuge. For more information, please contact the Kenai National Wildlife Refuge Visitor Center at 907-262-2820, Tuesday through Saturday from 10 AM – 5 PM or check out the Refuge website at <http://www.fws.gov/refuge/kenai/>.*



# Working at the Kenai Refuge is more than a job

by Macey Hoffman



*Ranger Macey teaches summer campers about the impacts of pollution to waterways on the Kenai National Wildlife Refuge.*

The annual rush of tourists and new explorers coincides with summer days when the sun never really disappears. So when I showed up in Alaska in the middle of last winter's dark people frequently asked, "What brought you here?" To this I answered, "Well, to see the last Blockbuster in America of course!"

The even more exciting reason was that I got a nine-month internship through the Student Conservation Association at the Kenai National Wildlife Refuge. My official title is Environmental Education/Visitor Services intern but when I visit schools,

"Ranger Macey" is on my nametag. I get to hike trails during work hours, perform raps about animal scat, get kids excited about nature, and learn something new every day.

At the Refuge, I'm surrounded by some of the most environmentally knowledgeable people, who constantly inspire me and make me more certain of, and excited about, the career path I am on. Everyone has ended up here for unique and beautiful reasons, intentional or not. I decided to ask some staff what brought them here, why the Refuge is important to

them, and why they stayed. One thing was clear—you fall in love with this place fast.

“The Refuge was my backyard and I didn’t even know this job existed. This position has given me a new appreciation for the place I grew up in” said Donna Handley, Administrative Technician. Feeling a strong connection to the conservation goals the Refuge holds, she states, “You don’t just work here, it becomes a part of you,” something I can already attest to. Entomologist Matt Browser reflected on the Seven Lakes Trail being his first date location with his now wife. He speaks to the value of the recreation the Refuge provides, as well as the “beautiful landscape.” We live and work in the kind of place people dream about visiting; the gratitude is daily.

For Ranger Leah Eskelin, it was love at first site. She came to the Refuge as part of a volunteer trip during college. Alaska had always been a fairytale idea for her, and then it became a goal. Not only has the Refuge stolen her heart, but the community of the Kenai Peninsula as well. “The community was attractive; people take care of each other around here.” I smile as I recall her having me over for family dinner to try my first moose meal in the winter, agreeing there are so many kind people.

Leah also said “I have stayed because my job protects the lifestyle that I was attracted to in the beginning. Other land is being turned into subdivisions and we get to protect this landscape that we all love.” She appreciates the endless outdoor activities, breathtaking sights, opportunities for harvesting food for the fridge, and general well-being that comes along with a dose of nature.

Even more, education and constant learning are bonuses for all of the Refuge divisions. “We are educating the public which is crucial for conserving, but even I am learning constantly, which makes my position even more enjoyable,” said Debbie Perez, Refuge Clerk.

I found many themes while engaging staff during

these reflective conversations. The people who work at the Refuge love nature. They want to encourage a lifestyle that understands our environment and lives to preserve it. They find purpose and passion in coming into work every day, earning their titles as environmental stewards.

The people who I work with have taught me that if I love the mountains, trees and rivers, it’s so important to connect others with nature because when you love something, you’ll take care of it. One of my favorite quotes by Baba Dioum, “In the end we will conserve only what we love; we will love only what we understand; and we will understand only what we are taught.” I specifically enjoy working with kids (which is where my position is focused) because it is extremely refreshing to experience people so excited about learning, exploring what’s around them, and discovering themselves and their interests.

The Refuge is important to me because the role that nature plays in my life is big one—we’re in a pretty serious relationship. Though going to Blockbuster and renting too many seasons of *Greys Anatomy* is tempting (and has happened before), I cannot think of an instance I regretted my time in nature. The wilderness makes me wonder, question, and feel beautifully lost, but it also brings me clarity and peace like nothing else does. Though nature is more complex and bigger than I can comprehend, it also has a way of reminding me to enjoy the simple things. These are all thoughts I believe everyone deserves, and need to benefit from. Whether the Kenai Refuge was on a to-do list or stumbled upon, the staff behind the Refuge come to work thankful and determined to protect and conserve for generations to come, and these feelings are pretty contagious.

*Macey Hoffman has been a Student Conservation Association intern at the Kenai National Wildlife Refuge since February. You can find more information about the refuge at <http://www.fws.gov/refuge/kenai/> or <http://www.facebook.com/kenainationalwildliferefuge>.*



## Ruffed grouse on the Kenai Peninsula

by John Morton



*A male ruffed grouse shows its black “ruff” while displaying on a drumming log in central Wisconsin (credit: J. Bronsdon). Ruffed grouse were introduced to the Kenai Peninsula in 1995–97.*

I don’t hunt game birds much anymore, partly because I don’t have a decent bird dog and partly because ptarmigan and spruce grouse just don’t have that magical way of flushing when you least expect it. Somehow ruffed grouse choose to fly when you’re ducking under brambles or when a tree is between you and them. It’s not surprising that the 2003 Grouse Hunter’s Guide states the “ruffed grouse is the most difficult game bird to bag in North America.” I confess I started drinking coffee in high school not to study, but to prepare myself for the afternoon hunt.

That same book provides the hunting statistics for the 357 members of the Loyal Order of Dedicated Grouse Hunters in 2001–02. While some hunters shot more than 30 birds during that hunting season, the average take was 8 birds per hunter, representing 24

shots and 48 hours of hunting. Presumably the Loyal Order really is comprised of dedicated grouse hunters. When surveys include run-of-the-mill hunters, success rates drop to 1 bird killed per 6 or 7 shots.

I have (or had) bragging rights. In the early 1980s, I spent most of a year working in central Wisconsin at the Sandhill Wildlife Demonstration Area. Among other tasks, I was paid to chase down male grouse as they drummed on their logs in the spring. I thought I had died and gone to heaven. That fall, I hunted them and their broods, shooting almost 50 birds, making me the #1 grouse killer in Wood County that year based on hunter check station tallies.

So I’m a little disappointed that ruffed grouse aren’t native to the Kenai Peninsula. They exist throughout the boreal forest wherever hardwoods oc-



cur which means, in Alaska, they are found in the Yukon, Tanana and Kuskokwim River valleys. They also occur in Southeast Alaska along the lower Stikine and Taku Rivers.

Why they don't occur naturally south of the Alaska Range likely has to do with glaciation as their natural distribution in Alaska roughly coincides with those of tamarack (larch) and wood bison. Unlike spruce grouse that eat spruce needles and buds in winter, ruffed grouse prefer male flower buds of aspen in winter and they often roost under snow during extreme cold—so perhaps the distribution of aspen with adequate snow depth ultimately limits their distribution in the Far North.

Yet when 140 ruffed grouse were transplanted from south of Fairbanks to the Matanuska Valley during 1988-1990, they immediately began to populate the area, eventually dispersing 80 miles from their original release sites and are now spreading down the west side of the Cook Inlet.

But when 232 grouse were introduced to the Kenai Peninsula in 1995-97, the results weren't so spectacular. They were released on sites at Atkins Road near Sterling, Quartz Creek north of Sunrise, and Captain Cook State Park. There was clearly some early breeding as 7 broods were sighted by the end of 1997 but drumming grouse surveys were discontinued after five years. Although hunting regulations still allow the harvest of 1 ruffed grouse per day in Game Management Units 7 and 15, you'll be hard pressed to find any ruffed grouse.

I suspect the introduction didn't take well because aspen tends to grow in burned areas on the Kenai Lowlands whereas deeper snow occurs in the mountains. Ruffed grouse in Alaska need both, not one or the other. To make matters worse, the release occurred almost 3 decades after the last big wildfire north of the Sterling Highway in 1969, past prime for ruffed grouse

that prefer 15 to 20 year-old aspen stands. There have been a handful of recent sightings of ruffed grouse in the Skilak Wildlife Area on the Kenai National Wildlife Refuge in 2014 and near Tern Lake in 2011, but I personally haven't heard a drumming grouse in my 15 years on the peninsula.

When ruffed grouse drum, they neither beat their wings on the log nor are they beat on each other. The low-frequency drumming noise is created by the vacuum formed from their cupped wings on the upstroke. Part of their nuptial noise-making behavior on the log (or sometimes a hummock) involves the male erecting its neck feathers (the "ruff") while fanning out its tail feathers. Its scientific name, *Bonasa umbellus*, refers to the similarities between the drumming and the bel-lowing of bulls or bison (*Bonasa*), and its ruffed neck feathers and an umbrella (*umbellus*).

Unlike spruce grouse, ruffed grouse populations vary with the 10-year snowshoe hare-lynx cycle. However, their peaks and lows lag behind snowshoe hares, suggesting that lynx switch to grouse as their primary prey only after hare populations start to decline.

Ruffed grouse still range as far south as northern Georgia, following the Appalachian Mountains. Fossil evidence from 15,000 years ago indicates that ruffed grouse were common even further south in Louisiana, Florida and Alabama during the Wisconsin Ice Age. With the accelerated warming of our contemporary climate, ruffed grouse populations in their southern range are likely to wink out. But my guess is that they will do well in interior Alaska in response to more wildfire and the conversion of softwood to hardwood.

*John Morton is the supervisory biologist at Kenai National Wildlife Refuge. You can find more information about the refuge at <http://kenai.fws.gov> or <http://www.facebook.com/kenainationalwildliferefuge>.*

## Yes, earthworms are changing the Kenai

by Matt Bowser



*What is wrong with this picture? These cottonwood roots grew underground but are now exposed after European nightcrawlers and two other earthworm species consumed the upper soil layers near the boat launch at Stormy Lake (credit: M. Bowser/USFWS, September 15, 2016).*

Last month when I stepped into the woods after a day's work on Stormy Lake I saw a sight I had seen only in pictures from the Upper Midwest. "Oh my goodness!" I declared as a question of mine was immediately, strikingly answered.

The upper soil layers were completely gone! Here, under cottonwoods, birches, alders, and devil's club, the forest floor should have been blanketed with a thick carpet of last fall's leaves and several inches of decomposing leaf litter underneath. These thick layers had disappeared, leaving formerly underground tree roots exposed. This is exactly the same story that played out around the Great Lakes, where exotic earthworms removed the upper soil layers at rates of up to three inches per year, baring tree roots and leading to

real ecological changes.

Earthworms first came to the attention of biologists at the Kenai National Wildlife Refuge in 2010. This concern culminated in research led by Deanna Saltmarsh, an Alaska Pacific University graduate student, who reported on the distribution and abundance of exotic earthworms on the Refuge (<http://bit.ly/2dWpgVn>). We now have a good idea of which earthworm species are present, where they tend to occur, and even how they got there, but we had not previously seen any real consequences of this invasion on the Kenai Peninsula.

Now we know, and the answer is "yes", earthworms do and will change things here.

I returned to Stormy Lake last week to find out



which earthworm species were culpable and to measure how much soil had been lost. Pouring mustard solution on the ground, which irritates earthworms, brings them “screaming” to the surface. The results were definitely impressive at Stormy Lake. I could have filled jars with European nightcrawlers longer than my hand fleeing the temporarily caustic soil. In smaller numbers were two other exotic earthworm species: octagonal-tail worms and gilt-tail worms.

Up to nine vertical inches of soil have been removed here, leaving tree roots completely suspended above the ground in places. All leaf litter was consumed; only leaves that fell recently graced the ground. Under the new leaves a continuous, shallow covering of worm castings covered mineral soil.

We know now that exotic earthworms can remove

the upper soil layers here as has happened in the Upper Midwest, but what will this mean for plants and animals of the Kenai Peninsula? You probably learned that earthworms are good for garden plants, and this is generally true. Earthworms do make a garden richer, speeding the decomposition of organic matter, so some plants benefit. And here on the Kenai, some earthworm predators such as American robins and even coho salmon make good use of this previously unavailable food resource.

The flipside is that what is beneficial to some species may be detrimental to other species. In the Great Lakes region, earthworms have caused local declines in animals and plants that depend on a thick leaf litter layer including ovenbirds, red-backed voles, shrews, salamanders, shield ferns, and star flowers.



*At least 17 earthworms crawl out of the soil in response to mustard powder solution. Note the absence of decomposing leaves; only coarser, woody material remains above mineral soil. (credit: M. Bowser/USFWS, October 13, 2016).*



We can make educated guesses as to how plants and animals on the Kenai Peninsula might respond as earthworms spread and alter soil properties. Of our forest types, spruce and hemlock should be impacted the least because most earthworms do not like the acidic soils of conifer forests. Hardwood forests, such as what surrounds Stormy Lake, are where changes should be most dramatic. Here, understory plants like ferns, star flowers, and watermelon berries are likely to decline while grasses may become more abundant. Our voles and shrews may be disfavored by the loss of leaf litter while robins stand to benefit.

Earthworms, especially European nightcrawlers, also have the potential to change our forests more directly by eating seeds—lots of them. They prefer smaller seeds like birch over larger seeds like spruce, removing up to 100% of birch seeds deposited on the soil surface, but worms are probably less important seed consumers than rodents in natural settings.

Thankfully, earthworms generally do not get

around well on their own, spreading at a glacial rate of less than 30 feet per year. The nightcrawlers at Stormy Lake, as with populations established at Canoe Lake and other popular fishing lakes on the Kenai Peninsula, were almost certainly released there by anglers. Even at Stormy Lake, it appears that only an acre next to the boat launch has been dramatically affected by earthworms to date. One hundred yards up the access road I found a thick, intact layer of decomposing leave litter and only one nightcrawler. Three hundred yards away near the Spur Highway I found no nightcrawlers.

We can still truly say that most of our natural landscape has been little changed by European earthworms being introduced to the Kenai. But now we know that this is beginning to change, dramatically so in some places.

*Matt Bowser serves as Entomologist at the Kenai National Wildlife Refuge. You can find more information at <http://www.fws.gov/refuge/kenai/> or <http://www.facebook.com/kenainationalwildliferefuge>.*

## Reflecting on the conservation legacy of Ding Darling

by Dawn Robin Magness



Political cartoon by Ding Darling from 1936 titled *Nobody's Constituents* (Courtesy of the Jay N. 'Ding' Darling Wildlife Society). The University of Iowa hosts a data base archive of his cartoons (<http://digital.lib.uiowa.edu/ding/>).

This month marks the 140<sup>th</sup> birthday of J. N. "Ding" Darling. Ding was a political cartoonist and a key figure in American wildlife management and conservation. After noticing a tribute in my son's *Ranger Rick* Magazine, I began reading a biography by David Lendt titled *Ding: The Life of Jay Norwood Darling*. As I read his life story, I cannot help reflecting on how his drawings, political satire and love of wildlife helped to es-

tablish the lands we have access to here, such as the Kenai National Wildlife Refuge.

Ding Darling was born on October 21, 1876. His father's work as a minister moved the family from northern Michigan to Indiana and finally to Sioux City, Iowa, when Ding Darling was 10 years old. At that time, Sioux City was on the edge of the frontier. Ding hunted and fished a prairie landscape where game,

such as the Greater Prairie Chicken, was abundant. He watched the prairie chicken become a rarity as grasslands were subdivided and plowed, an experience that molded his values. He once said, “If I could put together all the virgin landscapes which I knew in my youth and show what has happened to them in one generation it would be the best object lesson in conservation that could be printed.”

Ding began carrying around a sketch pad as a boy. His unflattering, yet recognizable, cartoons of faculty during a stint as the yearbook art editor at Beloit College in Wisconsin earned him a year-long suspension. He did manage to graduate in 1900 and returned to Sioux City to work as a sketch artist and journalist for the local newspaper.

Some of his first cartoons supported President Theodore Roosevelt’s conservation efforts. In 1903, President Roosevelt established the first National Wildlife Refuge, Pelican Island, with an executive order to provide a sanctuary for birds being overhunted because feathers were needed for the fashion industry. In less than a decade, Roosevelt went on to establish a total of 52 bird and 4 big game reserves—the beginnings of the National Wildlife Refuge System.

Fortunately, Ding’s talent brought in a job offer from the *Des Moines Register and Leader* because he was fired in 1906 for offending his previous publisher with a drawing of the Sioux City school board president. In Des Moines, Ding had the freedom to draw provocative political cartoons about a wide-range of subjects. By the time he retired in 1949, Ding Darling had become a household name, his cartoons syndicated in 150 newspapers nation-wide and the recipient of two Pulitzer Prizes.

Ding Darling was an active member of the Grand Old Party (GOP). After being a delegate to the Republican National Convention in 1932, he could barely squash rumors and calls for him to run for a senate seat in Iowa. He was unwilling to run for political office because he felt he would lose the freedom and independence he exercised as a cartoonist to unabashedly critique policies. He was frustrated that short-term political considerations kept politicians from doing what was needed to conserve limited natural resources.

In the 1930s, the Dust Bowl was a national crisis. Drought coupled with the agricultural practice of deep plowing the prairies resulted in the irrevocable loss of top soil blowing away in the wind. Waterfowl populations were in steep decline. Ding had been serving

on the Iowa Fish and Game Commission and on an advisory board that was recommending seasons and bag limits for waterfowl.

In 1934, President Franklin Roosevelt appointed Ding Darling and other forward thinkers in wildlife management, such as Aldo Leopold, to the Committee on Wild-Life Restoration. The Committee on Wild-Life Restoration recommended the federal government purchase 12 million acres of marginal lands for wildlife purposes and that funding be provided to restore and manage these lands. Concurrently, The Migratory Bird Hunting Stamp Act, commonly called the Duck Stamp Act, was moving through Congress. The Duck Stamp Act required hunters to purchase a stamp to generate money for habitat protection, management and enforcement.

After those recommendations, President Franklin D. Roosevelt asked Ding to serve as Chief of the Bureau of Biological Survey (precursor to the U.S. Fish and Wildlife Service). At first, Ding was reluctant to “aid and abet” the political opposition. However, Ding was promised the funding to build the refuge program. Four days after his appointment was announced, President Roosevelt signed the Duck Stamp Bill.

Ding only served for 18 months, but in that time he designed the first Federal Duck Stamp. He worked tirelessly to reorganize the Bureau of Biological Survey into an effective agency and needled the President and Congress for the funding needed to implement his vision. Under his tenure, the agency cracked down on illegal market hunting, began purchasing and restoring retired agricultural lands for wildlife, and instituted hunting restrictions to allow waterfowl populations to recover.

The Alaska National Interest Lands Conservation Act (ANILCA) designated 76 million acres of land in our state as national refuges. Two million of those acres comprise the Kenai National Wildlife Refuge, established 4 decades before ANILCA, as much Ding’s legacy as it was President Roosevelt’s. Ding Darling fought for wildlife to have a place in developing landscapes, as reflected in his cartoon *Nobody’s Constituents*. Reading about Ding’s life has made me even more appreciative that life on the Kenai Peninsula includes ready access to large tracks of land set aside for wildlife.

*Dr. Dawn Robin Magness is the landscape ecologist at the Kenai National Wildlife Refuge. You can find more information at <http://www.fws.gov/refuge/kenai/> or <http://www.facebook.com/kenainationalwildliferefuge>.*



## Revisiting Aldo Leopold's *A Sand County Almanac*

by Ted Bailey



*Aldo Leopold was made a Professor of Game Management at the University of Wisconsin-Madison in 1933, the first such program in the U.S. He wrote *A Sand County Almanac* in 1949 just before his death (photo credit: <http://oregonwild.org/>).*

As part of the 75<sup>th</sup> birthday celebration for the Kenai National Wildlife Refuge, I watched Jim Pfitzer's portrayal of Aldo Leopold in *A Standard of Change* at the Kenai Chamber and Visitor Center on October 8. This wonderfully performed skit motivated me to dig out my old time-worn copy of Leopold's *A Sand County Almanac* and read it again—at least for the third time—but not recently. This book was written in 1949 and published shortly after his death.

Aldo Leopold is considered to be the founder of the science of wildlife conservation and management. I was first inspired by reading *A Sand County Almanac* as an undergraduate student majoring in zo-

ology in the early 1960s. Leopold's book (and others) and my own observations while serving overseas in the military of the manipulated, manicured and degraded landscapes throughout much of Europe, especially around the Mediterranean, inspired me to become a wildlife conservationist. It still inspires me today.

I was particularly interested in reading again what Leopold had to say about Alaska and predators. Although he never visited Alaska, he mentioned our state several times in his book. In discussing the value and importance of wilderness, Leopold's "unused hinterlands" or "blank spaces on a map" were important

to him. He wrote: “Is my share in Alaska worthless to me because I shall never go there? Do I need a road to show me the Arctic prairies, the goose pastures of the Yukon, the Kodiak bear, the sheep meadows behind McKinley?”

He foresaw the loss of wilderness with the building of roads and motorized access. “The retreat of wilderness under the barrage of motorized tourists is no local thing; Hudson Bay, Alaska, Mexico, South Africa are giving way, South America and Siberia are next.” One has to remember that this was written in 1947 before Alaska was even a state! Seeing Alaska as one of the last places to preserve wilderness he wrote: “To what extent Canada and Alaska will be able to see and grasp their opportunities is anybody’s guess. Pioneers usually scoff at any effort to perpetuate pioneering.”

In regards to predators, Leopold, as a young man, first only thought of killing predators convinced it would produce more game. He said “In those days we had never heard of passing up a chance to kill a wolf.”

But later in life Leopold, a hunter, wrote “Wildlife administrators are too busy producing something to shoot at to worry much about the cultural value of the shooting.” He also wrote “Very intensive management of game or fish lowers the unit value of the trophy by artificializing it.” He lamented the loss of the wolf and cougar in Yellowstone National Park and questioned the value of wilderness and parks without their native

fauna.

His change from killing to protecting predators is best summed up in his essay “Thinking Like a Mountain,” based on his reflections as he watched a wolf that he and others had shot die. He wrote: “We reached the old wolf in time to watch a fierce green fire dying in her eyes. I realized then, and have ever known since, that there was something new to me in those eyes—something known only to her and to the mountain. I was young then and full of trigger-itch; I thought that because fewer wolves meant more deer, that no wolves would mean hunters’ paradise. But after seeing the green fire die, I sensed that neither the wolf nor the mountain agreed with such a view.”

Leopold died of a heart attack while battling a wildfire on a neighbor’s property in Wisconsin. But if Leopold came back today, he probably would be pleased to know that wolves and cougars are back in the Yellowstone and that large conservation units and wilderness areas, with their native fauna, have been established in Alaska.

*Dr. Ted Bailey was the supervisory wildlife biologist at the Kenai National Wildlife Refuge before retiring in 2001. He has lived on the Kenai Peninsula for over 40 years. Find more information about the refuge at <http://www.fws.gov/refuge/kenai/> or <http://www.facebook.com/kenainationalwildliferefuge>.*

## World War II veterans and their roles in Kenai Refuge history

by Ted Bailey



*Dave Spencer, the first manager of the Kenai National Moose Range (now Kenai National Wildlife Refuge) surveys a trumpeter swan nest on the Moose River in May 1957. Two months later, oil was discovered in the Swanson River Field, setting off an era of active oil exploration and development on the refuge under the management of John Hakala. Both managers were pilots in WWII.*

As Veteran's Day approaches and after reading an article on the recent book *Mission to the Kurils* in the *Alaska Dispatch News* on November 6, I could not help but think of World War II veterans Dave Spencer and John Hakala, both former managers of the Kenai National Moose Range, now known as the Kenai National Wildlife Refuge. I was fortunate to know both men, but particularly John Hakala who was my neighbor for

over 20 years. Both are deceased.

Dave Spencer was a naval aviator and flight instructor who enlisted in the Navy in 1942. After World War II ended, Spencer, a proficient pilot in amphibious aircraft, flew migratory waterfowl surveys throughout the country for the Bureau of Sport Fisheries and Wildlife (now the U.S. Fish and Wildlife Service) before reporting for duty as the first manager of the Kenai



National Moose Range in 1948. The Moose Range, as many old-timers still call it, was established seven years earlier as America was entering WWII with the bombing of Pearl Harbor.

Spencer not only had to deal with being the first to manage what was then a relatively new and complex refuge, but was also instrumental in protecting National Wildlife Refuges throughout Alaska. His contributions to the Kenai Refuge—establishing the Swanson River and Swan Lake canoe systems and the Andy Simmons Research Natural Area—and to Alaska, and other interesting stories of his tenure were documented by former refuge manager Robin West in *Refuge Notebook* Vol. 2, No. 11 (2000).

John Hakala enlisted in the U.S. Army Air Corp 1940, became a pilot, and flew B-25s from the Aleutian Islands on many bombing missions to the Kuril Islands, held by the Japanese at that time. Later, he also flew missions in the South Pacific.

After the war, as a young boy, I watched B-25s often pass low over our house in a rural area. The unique drone of their reciprocating engines and twin tail is still vividly etched in my memory.

And probably because I was a veteran of the Air Force with an interest in World War II aircraft, John told me stories of his wartime flying experiences. He said flying in the severe weather of the Aleutians, the long missions over water often on instruments, and

running out of fuel probably accounted for more losses of aircraft and crew than the enemy.

John was refuge manager during the exploration and development of oil and gas resources on the Kenai Refuge. Recently-arrived residents of the Kenai Peninsula are often unaware that the 1957 Discovery Well for Alaska is on the Kenai Refuge. The ensuing time was a very controversial period in refuge history and John received a lot of pressure from the oil industry and politicians in his attempts to protect refuge wildlife and resources. More details about John's life are available in *Refuge Notebook* Vol. 8, No. 1 (2006).

Many World War II veterans have now passed away. My father's and mother's younger brothers both experienced action during World War II in the South Pacific. Fortunately, they, like Dave Spencer and John Hakala and many other veterans of that war, survived and upon returning further contributed as civilians to our country's prominence and admiration in the world. On November 11, we honor these and all living and deceased veterans for their service.

*Dr. Ted Bailey was the supervisory wildlife biologist at Kenai National Wildlife Refuge before retiring in 2001. He has lived on the Kenai Peninsula for over 40 years. Previous Refuge Notebooks can be found at [http://www.fws.gov/refuge/Kenai/community/refuge\\_notebook.html](http://www.fws.gov/refuge/Kenai/community/refuge_notebook.html).*

## Local high school students monitor fire management

by Allie Cunningham



*These local high school students worked together this past summer as the Youth Conservation Corps crew on the Kenai National Wildlife Refuge. From left to right: Grant Knauss, Haley Buckbee, Matthew Zorbas, Whitney Esteban and Talon Musgrave (credit: Allie Cunningham/USFWS).*

“The GPS says the plots are on the other side of the swamp in front of us. There isn’t a way around it,” Grant says as we assemble our gear. “I bet we can find a higher path that keeps us out of the water a bit...let’s give it a shot,” I reply.

Grant Knauss leads the way, navigating by GPS and his innate sense of direction. I watch as the five crew members discuss their options for staying dry. They choose to cross on a set of taller hummocks, and help each other by offering a hand to the next person

in line. We continue on and locate our first plot of the day. Grant swaps his GPS for a compass to find north, south, east and west from the center of the plot.

“Take two steps south. Ok, you’re right on west.” Matthew Zorbas places a pin flag to mark the western boundary. With the plot established, Haley Buckbee, Talon Musgrave, Whitney Esteban, Grant and Matthew begin their detailed collection of data.

“Three PIMA, lab tea, caribou lichen, f-moss.” Haley repeats as she records Talon’s vegetation point-



intercept findings at meter 2.5 of the plot. A few days ago, these plant species were a foreign language. “PIMA” is short for *Picea mariana*, the scientific name for black spruce, the predominant tree species in this, and many of the plots. Lab tea is short for Labrador tea. F-moss is Haley and Talon’s abbreviation for feather moss, the brilliant green that accounts for most of the ground cover in our black spruce forests.

To my right, Matthew is busy tallying trees by size class, using calipers to measure DBH (diameter at breast height) and marking the trees he measures with a yellow wax pen. Whitney meticulously records his findings, asking for clarification when she needs it. Grant assists by using an instrument called a hypsometer to determine the height and location of selected trees in each size class. As each group finishes the task at hand they move on quickly to another—verifying accuracy as they go.

Six weeks prior, the same five high-schoolers walked in to the Visitor Center at the Kenai National Wildlife Refuge and met each other for the first time. Over the weeks that followed, a culture of respect, support, and honest work ethic was established. This culture allowed us—the Youth Conservation Corps—an opportunity to assist the Refuge’s Fire Management Program with a monitoring project on the 8.5-mile fuel break being constructed around the community of Sterling. The fuel break will serve to better protect residents from wildfire, maintain firefighter safety, and allow for naturally ignited fire or prescribed fire to benefit wildlife habitat. To accomplish the objectives of the fuel break, hazardous (flammable) vegetation will be manipulated, reduced, or removed through a variety of techniques.

Fuels (or vegetation) monitoring is a key component in assessing the effects of these treatments. The 2016 Youth Conservation Corps assisted in surveying 21 of 75 16-meter plots within the fuel break boundaries. Monitoring allows the Fire Program to use the “best available” science to make decisions about how to manage the treatment of flammable vegetation. Plant identification, tree tallies, shrub density, down and woody debris, vegetation class, and topographic details about the plot were just a few of the elements included in fuels monitoring. Precision and attention to detail were of critical importance during this project, as the data gathered enters into not only a local or regional database, but a national one as well.

The YCC crew surprised me—their leader—and the fire staff with their ability to complete about five plots per day with good data integrity for the duration of the project. This was a great opportunity to learn a number of skills that will serve the crew well in everyday life (a sense of direction, knowledge of local plants), backcountry pursuits (GPS and compass navigation), and a way to better understand fire management on the Refuge.

Maybe, just maybe, this project served to inspire a few of the next generation botanists, foresters, fire management officers, youth crew leaders, conservation advocates—or keepers of the Kenai National Wildlife Refuge.

*Alexandra “Allie” Cunningham was the YCC Crew Leader this past summer at Kenai National Wildlife Refuge. Find more information about the refuge at <http://www.fws.gov/refuge/kenai/> or <http://www.facebook.com/kenainationalwildliferefuge>.*



*Grant Knauss uses a hypsometer to measure the height of a black spruce in the Sterling fuel break (credit: Mike Hill/USFWS).*



## Where do our Trumpeter Swans go in the winter?

by John Morton



*Swans fly over Barney Lake in northwestern Washington with Mt. Baker in the background. Trumpeter swans from the Kenai Peninsula winter along the Pacific coast from Cordova to Washington including Barney Lake and the surrounding farmland.*

Did you know that Trumpeter swans have been surveyed on the Kenai National Wildlife Refuge since 1957? Six decades ago, when only 20 pairs were known to nest on the Kenai Peninsula, Trumpeter swans were almost extinct in the Lower 48. Since then, swans have increased to about 50 nesting pairs on the Kenai, and breeding populations have been restored to much of their former range in the Western and upper Midwestern states.

As the biggest North American bird species, Trumpeter swans are slow to mature. They need 140–154 ice-free days to successfully complete a breeding cycle: 49 days for nest building, egg laying and incuba-

tion, and 90–105 days for cygnets to fledge and become fully flight capable for migration. The earliest known hatch date on the Kenai Peninsula is June 4, with the earliest cygnets fledging in mid-September and some as late as mid-October. As such, it becomes a dire race to fly before ice locks them in.

Now, with winter descending on the Kenai, most Trumpeter swans have flown the coop as lakes freeze up. A few swans may linger in open water on the Kenai River below Skilak Lake, but most are now headed south, scattered along the Inside Passage from the Copper River Delta to the Stikine River near Wrangell. But what's their ultimate destination?



*Bob Richey, former assistant refuge manager at the Kenai National Wildlife Refuge, helped place neck collars on many Trumpeter swans during the 1970s and early 1980s.*

Dairy farms. Yes, dairy farms that grow orchard grass and ryegrass as cover crops for silage during the winter. Agricultural landscapes like those that surround Duncan on Vancouver Island or the alluvial soils of the Fraser River delta or, in particular, the Skagit Valley in northwestern Washington. Swans, geese and dabbling ducks have learned to forage on these grasses to the dismay of local farmers.

Data from the Bird Banding Laboratory in Laurel, Maryland, show nine records of eight different Trumpeter swans that were originally neck-collared on the Kenai Refuge and were re-sighted on or near Barney Lake in the Skagit Valley during several winters in the 1970s and early 1980s. These birds were among 160 swans, mostly cygnets, which were neck-collared and leg-banded by refuge staff between 1966 and 1984 to understand swan movements and survivorship.

To get a more detailed understanding of brood movements among the many lakes and wetlands in the Kenai Lowlands, retired refuge biologist Ted Bailey and his staff tracked 45 Trumpeters during 1982–85 that were harnessed with VHF radio transmitters. One adult female captured on Kenaitze Lake in the northern lowlands eventually traveled more than 1,400 miles to the Barney Lake area between September 17 and December 2 in 1984.

In researching historical records of trumpeter swan management and research by the Kenai Refuge,

I ran into an interesting account in a 1980 report: “Swans banded on the Kenai National Wildlife Refuge continue to be observed at Barney Lake in Washington and on Vancouver Island in Canada. Barney Lake, a prime wintering area for Kenai trumpeters is being subjected to intensive development along its shores and the future of this wintering area is in jeopardy. However, there is a movement to proclaim this area as a swan preserve.”

Last week I met Martha Jordan, now the Executive Director of the Northwest Swan Conservation Association, who was a field biologist actively involved in re-sighting neck-collared swans around Barney Lake during those early years. In a 1980 paper, she wrote that an effort was underway by the Audubon Society, Friends of the Swan, what-was-then the Washington Department of Game, and The Nature Conservancy to protect this wintering area. After a petition drive, these co-conspirators succeeded in getting the Barney Lake vicinity designated a “steel shot ammunition only” hunting area, 12 years before the steel shot prohibition for waterfowl hunting became a nationwide mandate. By 1995, the Skagit Land Trust began conserving lands around Barney Lake for wintering waterfowl including Trumpeter swans.

Consider that in 1957, as aerial surveys for swans were being inaugurated on the Kenai Refuge, only six Trumpeters were recorded at Barney Lake. By 1980, 355 swans wintered there. There are now 7,000 Trumpeters and 2,000 Tundra swans wintering in Skagit County, and perhaps 15,000 swans in the greater Skagit-Whatcom area.

The Kenai Refuge has done its small part in helping Trumpeter swans recover by providing good breeding and staging habitats with minimal aircraft disturbance of nests and broods during the summer and fall, and prohibited motorboat activity below Skilak Lake during the spring. Our small population of nesting swans on the Kenai Peninsula has cumulatively contributed more than 3,500 cygnets over the past six decades to the Pacific Coast meta-population that now numbers almost 6,000 pairs in Alaska. What a great conservation success story!

*Dr. John Morton is the supervisory biologist at Kenai National Wildlife Refuge. Find more information about Trumpeter swans through the Trumpeter Swan Society (<http://www.swansociety.org/>). Find more information about the refuge at <http://www.fws.gov/refuge/kenai/> or <http://www.facebook.com/kenainationalwildliferefuge>.*



# A time for reflection—Kenai National Wildlife Refuge’s 75<sup>th</sup> anniversary (Part I)

by Andy Loranger



*A sign on the Swanson River Road in 1970 announces entry to the Kenai National Moose Range, established 29 years earlier by President Roosevelt.*

On December 16, 1941, President Franklin D. Roosevelt issued Executive Order 8979 establishing the Kenai National Moose Range. The eve of its 75<sup>th</sup> anniversary presents an ideal moment to reflect on the history of the Moose Range, later to become the Kenai National Wildlife Refuge.

At the time of Russian settlement in late 1700s, the Kenai Peninsula’s rich fish and wildlife resources had long been known and revered by its first inhabitants. For millennia, Dena’ina people had made the Kenai Peninsula their home, as did Alutiiqs in the south and Chugaches in the east. The Dena’ina knew the Kenai as *Yaghanen*—the “good land”—and their lives were intimately intertwined with the seasonal abundance of salmon, wildlife and berries.

One hundred years later, word had spread beyond Alaska about the natural wonders of the Kenai. Dall DeWeese visited from Colorado in 1897 to hunt big game, acquiring the guiding services of Andrew Berg, the Kenai Peninsula’s first big game guide. As is the case in many wildlife conservation stories over the last century, hunters played a pivotal role here. DeWeese wrote several articles and sent letters to government officials about what he found, creating an interest in

Alaskan big game. It wasn’t long before the Kenai became famous for its large moose and abundance of “white sheep,” nor was it long before DeWeese and others began to warn of depletion of game populations due to overharvest.

Gifford Pinchot, who would later become the first chief of the U.S. Forest Service, commissioned William Langille in 1903 to investigate forest resources in Southcentral Alaska. Langille explored the Kenai in 1904 and followed up his expedition with a report entitled *The Proposed Forest Reserve on the Kenai Peninsula*. He acknowledged the need for wildlife and habitat protection in the area, noting: “The forest cover in its primal state is also very essential to the prolonged existence of the living game, which represents the best types of its kind and if cared for, will be a source of revenue to the inhabitants and pleasure to the world for many years to come ... and in consideration of this and the other circumstances mentioned I have the honor to recommend the creation of the Kenai Forest Reserve.” Langille’s expedition helped set the stage for establishment of the Chugach National Forest by President Teddy Roosevelt in 1907 and its expansion in 1909 to include most of the current Refuge.

In the ensuing years, interest in settling the Kenai Peninsula and increasing demand for its spectacular wildlife resources created conservation concerns. The last caribou on the Kenai was killed circa 1915, and wolves were extirpated through an extensive poisoning and shooting campaign around the same time. Moose populations were declining. In 1931, the Alaska Game Commission recommended establishing a moose sanctuary, by executive proclamation, on the Kenai. Many in the community helped sound the alarm—among those was big game guide Andy Simons who advocated for more protection to conserve game populations.

Ten years later, bolstered by strong advocacy from the U.S. Fish and Wildlife Service’s first Director Ira Gabrielson, F.D.R. established the Kenai National Moose Range “... for the purpose of protecting the natural breeding and feeding range of the giant Kenai



moose on the Kenai Peninsula, Alaska.” It is a wonder that President Roosevelt had the vision and sense of purpose to establish a conservation area in distant Alaska at a time when his attention must have been so focused on the attack on Pearl Harbor only nine days earlier and on events in Europe.

In 1948, World War II veteran and pilot Dave Spencer arrived on the Kenai to assume his duties as the Moose Range’s first Refuge Manager. Within two years, he developed an extensive research program that set a very high bar, and that in many aspects continues even today. His aviation legacy was the first in a long line of Refuge pilots that have contributed significantly to wildlife and resource protection and scientific discovery over the ensuing seven decades. Early work included studying vegetation and wildlife response to a large wildfire, started by a road construction crew the year before Mr. Spencer’s arrival. The 1947 burn consumed over 300,000 acres of spruce forest mostly north of Skilak Lake and the Kenai River, creating favorable habitat to which the moose population responded dramatically.

While modern wildlife management and scientific research were being introduced to the Moose Range, demand for oil exploration and development, and pressure to remove areas of the Range to allow for settlement, would result in large-scale changes. Oil discovery in the Swanson River area in 1957 created an economic boon but also brought industrial development and new roads to the relatively pristine Moose Range. Mr. Spencer and his successors, John Hakala and Will Troyer, worked to protect remaining areas, seeking innovative ways to conserve the Moose Range’s wildlife and wildlands. One approach was the designation of an 806,000-acre Research Natural Area in its eastern portion, to be managed so as to allow natural ecological processes to function and to protect wildlife that depended on large and undisturbed tracts of land.

Industrial development within the Moose Range also had the indirect effect of helping to usher in an

era of increased outdoor recreational access and activities. The establishment of a dedicated canoe route took advantage of this new access and helped generate great interest in new outdoor recreational opportunities on the Kenai. The now nationally-designated Swanson River and Swan Lake Canoe Trail System became a cornerstone of wilderness-type recreation in southcentral Alaska.

Twenty years after its establishment in 1941, agency management activities, the reappearance of a large predator, and another major wildfire would greatly influence wildlife populations on the Kenai National Moose Range. In the 1960s, the Alaska Department of Fish & Game and the Refuge cooperatively translocated caribou from the Nelchina herd, beginning the reintroduction of a species absent from the Kenai since the early 1900s. Coincidentally, wolves re-established themselves on the Kenai by the mid-1970s, after a nearly 50-year absence. In 1969, the Swanson River wildfire burned 86,000 acres, to which the moose population again responded, reaching some of its highest densities in the ensuing 25 years. This period also marked the initiation of active habitat management on the Moose Range with the use of giant Le-Tourneau tree crushers and, later, prescribed fire.

In 1979, the Refuge headquarters moved from Kenai, where the original Quonset building which served as the Moose Range’s first office in 1948 still stood, to its current location south of Soldotna. The new facilities included a Visitor Center to serve residents and tourists.

*Andy Loranger is Refuge Manager of the Kenai National Wildlife Refuge. Part II of this article will appear next week and will explore the Refuge’s more recent history. The public is cordially invited to help celebrate the Refuge’s 75<sup>th</sup> anniversary on Friday, December 16 from 5–7pm at the new Refuge Visitor Center on Ski Hill Road in Soldotna. For more information, please call 907-262-7021.*

## Celebrate Kenai National Wildlife Refuge's 75<sup>th</sup> birthday!

by Candace Ward



*Come celebrate the 75<sup>th</sup> Birthday of Kenai National Wildlife Refuge on December 16!*

Celebrate Kenai National Wildlife Refuge's 75<sup>th</sup> Birthday on Friday, December 16, from 5 – 7 PM, at the Kenai National Wildlife Refuge Visitor Center on Ski Hill Road, one mile from Soldotna. This is a free event for the public and features fun, family activities, light refreshments and, of course, birthday cake.

Family activities include a wildlife art scavenger hunt, making moose antler headbands, and dressing up as animals at the 75<sup>th</sup> photo booth for a “take home” photo memento. Each family participating in these activities receives a free commemorative bull moose poster and other treats.

Come see the new permanent exhibit of Kenai Refuge artwork created and donated by Tom Collopy and Mary Frische of Wild North Photography based in Homer, Alaska. Over the last 4 years, Mary and

Tom have traveled the Refuge in all seasons capturing amazing photos of scenic vistas, wildlife, and visitors having fun. Tom and Mary will give a short presentation, beginning at 6 PM, sharing their explorations in the wilds of Kenai Refuge and other Alaskan National Wildlife Refuges over the last decade.

The Refuge will also recognize the winners of the “75 Things to Do on the 75<sup>th</sup> Birthday” contest. Winners will share their memorable Refuge experiences over this last year and give us all inspiration for future adventures.

Has your family enjoyed the “75 Things” activity? Don't forget to come in to the Refuge Visitor Center between now and December 10<sup>th</sup> to get your commemorative participation gift (25 things or more required). When you turn in your checklist, you will be

entered into the grand prize contest. Awards include a public-use cabin stay, a gift bag of Refuge gear from the Alaska Geographic store, and a miniature statue replica of “Majesty of the Kenai,” the bronze statue you see in this article’s photo and which welcomes visitors at the Visitor Center’s entrance plaza.

We are fortunate to have generous non-profit partners who have helped fund this event and make it possible for us to have refreshments and give out prizes. These partners include the National Wildlife Refuge Association, Friends of Alaska National Wildlife Refuges, National Wildlife Refuge Retiree Association, and Alaska Geographic.

For those who appreciate and love the land

and wild community that is Kenai National Wildlife Refuge, please join us for a wonderful evening celebrating our Refuge as a very special place for the last 75 years.

*Candace Ward is a park ranger in the Visitor Services Program at Kenai National Wildlife Refuge. She has worked at the Refuge for 32 years and experienced the 50<sup>th</sup>, 60<sup>th</sup> and 70<sup>th</sup> celebrations. The 75<sup>th</sup> will be the best one yet! For more information, please contact the Kenai National Wildlife Refuge Visitor Center at 907-260-2820, Tuesday through Saturday from 10 AM – 5 PM or check out the Refuge website at <https://www.fws.gov/refuge/kenai/>.*



## A Time for Reflection—Kenai National Wildlife Refuge's 75<sup>th</sup> Anniversary (Part II)

by Andy Loranger



*A sign on Ski Hill Road announces entry to the Kenai National Wildlife Refuge, so named in 1980 with passage of the Alaska National Interest Lands Conservation Act.*

*(This is the second of a two-part article on the history of Kenai National Wildlife Refuge.)*

As the Kenai National Moose Range approached its fourth decade, Congress passed two laws which profoundly affected its management. The 1971 Alaska Native Claims Settlement Act, signed by President Nixon, addressed land claims of Native peoples throughout Alaska including land claims within the Refuge which, once adjudicated, resulted in substantial withdrawals of surface and subsurface estate. This act also required a review of lands to be set aside for conservation and other values, which led to the Alaska National Interest Lands Conservation Act. Signed by President Carter in 1980, ANILCA designated over 100 million acres of federal conservation system units in Alaska.

Under ANILCA, the Moose Range became the Kenai National Wildlife Refuge. Its purposes were broadened to include conservation of all fish and wildlife and habitats in their natural diversity; meet-

ing international fish and wildlife treaty obligations; protecting water quality and quantity; providing opportunities for scientific research, interpretation, environmental education and land management training; and, in a manner consistent with all of these purposes, providing opportunities for fish and wildlife oriented recreation.

ANILCA also added lands to the new Refuge and established the 1.3 million-acre Kenai Wilderness, forever underscoring the Refuge's wilderness values and mandating their protection. The newly-designated Wilderness effectively cemented the early vision of Dave Spencer, the Refuge's first manager, to protect the Kenai's pristine backcountry.

A guide to implement its expanded mission was needed so the Refuge's first Comprehensive Conservation Plan was finalized in 1985. To develop this management blueprint, the Fish and Wildlife Service sought unprecedented input from local and national

interests. A major purpose of ANILCA was to “... provide the opportunity for rural residents engaged in a subsistence way of life to do so” on federal lands in Alaska. Providing for, and administering subsistence uses of, fish and wildlife resources on the Refuge would become a new responsibility in the 1990s.

The Refuge’s biological program expanded following the passage of ANILCA, and focused on providing information needed by managers to properly balance increasing demands for recreational access with sound conservation of fish and wildlife resources. Cooperative surveys and studies with the Alaska Department of Fish & Game for moose and caribou were conducted. Research and surveys were initiated or expanded for species sensitive to increasing levels of public use, including trumpeter swans, bald eagles, and several furbearing species including wolves, lynx, beaver, wolverine and marten. The Interagency Brown Bear Study Team, composed of biologists from ADF&G, Chugach National Forest, Kenai Fjords National Park and Kenai Refuge, was launched to help ensure the conservation of Kenai brown bears. Kenai Fish & Wildlife Field Office colleagues helped obtain needed information about fisheries resources on the Refuge.

Roadside recreational development on the Refuge expanded with new and improved facilities at Russian River, Skilak Loop, Hidden Lake and Swanson River and Swan Lake Roads. Thousands of new visitors soon discovered these gems. An enhanced system of trails was developed, its subsequent maintenance coincidentally creating great opportunities for involving young people in public lands stewardship through programs such as the Youth Conservation Corps.

In 2005, a plan was finalized for the management of Refuge public use cabins. Through new construction and restoration of historic structures, 16 cabins are now available for the public’s enjoyment. Several trails and cabins were added within the Skilak Wildlife Recreation Area, now managed with an emphasis on wildlife viewing. Growth of the Refuge’s environmental education program culminated in the 2003 opening of the Environmental Education Center adjacent to headquarters on Ski Hill Road.

The 25-year old Comprehensive Conservation Plan was revised in 2010 to bridge the lessons and successes of the past with challenges of the future. Today, collaborative fish and wildlife research studies and surveys continue, but new challenges have emerged requiring a different scientific focus. Refuge biologists

are working to understand and help plan for the impacts of a rapidly warming climate on fish and wildlife. Even as biologists have documented over 2,000 species on the Refuge, they are also examining how invasive plants and animals threaten this natural biodiversity. Management now emphasizes early detection and a rapid response to prevent new invasive infestations in still-pristine areas.

Two recent human-caused fires—the Funny River Fire in 2014 and the Card Street Fire in 2015—highlight the challenges posed by a rapidly developing wildland-urban interface and the continuing need to manage fire for ecological benefits to natural systems on the Refuge. As a result, the Refuge has expanded cooperative efforts with its interagency partners to reduce hazardous fuels near communities.

In May 2015, the Refuge dedicated a new state-of-the-art Visitor Center. The building includes “green” features: a sod roof, solar panels, a cozy masonry fire place, and energy efficient floor-to-ceiling windows that offer sweeping views of lake and mountain scenery. The exhibit hall welcomes visitors to explore the Refuge from “Icefield to Ocean” with colorful, interactive exhibits representing the diverse wildlife and their habitats on the Refuge. An expansive multi-purpose room gives a new venue for Refuge and community wildlife education programs.

Today, as we celebrate the Refuge’s 75<sup>th</sup> anniversary, Refuge staff do their best to serve residents and visitors alike. Visitor Services staff strive to maintain high quality recreational opportunities, and the Visitor Center and Environmental Education Center are hubs where creative programs connect youth with nature in ways that foster life-long appreciation. Refuge law enforcement officers work diligently to ensure natural and cultural resources are protected and visitors remain safe. Our highly skilled maintenance staff provide safe and welcoming facilities for Refuge visitors. Administrative professionals are the foundation which facilitates all of the Refuge’s work. Finally, community support and partnerships are recognized as critical to ensuring effective conservation into the future, working within and beyond Refuge boundaries.

*Andy Loranger is Refuge Manager of the Kenai National Wildlife Refuge. The public is cordially invited to help celebrate the Refuge’s 75<sup>th</sup> anniversary on Friday, December 16 from 5–7pm at the new Refuge Visitor Center on Ski Hill Road in Soldotna. For more information, please call 907-262-7021.*

## The long nights of winter

by John Morton



*Skiers enjoy the afternoon sun low on the horizon over Bottenintnin Lake on the Kenai National Wildlife Refuge.*

Yay! We're two days past the Winter Solstice, our longest night, headed in the right direction for day length. Good days of skiing and ice-fishing are ahead of us and eventually the birch sap will run, the snow geese will return and our gardens will grow.

Although we called this past December 21 the Winter Solstice, only for a brief moment at 1:44 AM Alaska Time did the sun actually "reach" its southern-most extent at the Tropic of Capricorn, where it was directly overhead at 23°26'13.5". At that instant, the sun "stood still" before the earth's 23.5 degree celestial tilt and its 365-day rotation around the sun made

it seem (to those of us standing on earth) that the sun was finally headed back north. And so we call this day the solstice, which means in Latin "to make the sun stand".

As the earth continues rotating around the sun, the sun will be directly over the equator on March 20, 2017, an event we call the spring equinox. On June 20, 2017, the sun will reach its northern-most extent, perching briefly over the Tropic of Cancer. At that moment, any part of earth north of the Arctic Circle, which we call the Arctic, will experience at least one 24-hour period of daylight. In other words, the sun is still above the



horizon at midnight—hence, the land of the midnight sun.

You can visit a sign at a rest area on the Dalton Highway, 59 miles north of the Yukon River, which marks the Arctic Circle. What's kind of cool about the Arctic Circle is that unlike the Equator, it is not a fixed position. Currently it runs 66°33'46.5" north of the Equator, but it is drifting northwards almost 50 feet per year due to fluctuations in the earth's axial tilt.

But on our longest night of the year, just before Christmas, you can bet that brown and black bears are deep in their dens, even as children are nestled all snug in their beds. With less than 5-and-a-half hours of daylight, marmots are deep in hibernation, the chickadees are hitting the bird feeders, and the moose stay close to their winter browse. Native evergreens like spruce, hemlock, juniper, lingonberry, crowberry, and clubmoss continue to do their best to photosynthesize in the waning light, but most plants have senesced, dropping their leaves back in the fall.

Watch, though, as the sun returns to the northern hemisphere over the next few weeks, even the next few days. It doesn't take long for our resident wildlife like bald eagles to become more vocal and active, putzing around last year's nest. Great horned owls start belting out their mating hoots in February.

Consider that many of our birds that migrate far to the south are having the time of their lives as we finish up our holiday shopping in crowded stores. It's easy to forget that migratory birds which breed in the high arctic and subarctic spend most of their year in warmer climates. Todd Eskelin, a biologist at the Kenai National Wildlife Refuge, sighted a migrating semipalmated sandpiper at the mouth of the Kenai

River that was originally banded on the beaches of Ecuador during winter. Aleutian terns, which nest in the wetlands surrounding Headquarters Lake behind the Kenai Refuge Visitor Center, are likely frolicking in the warm waters off Indonesia or Malaysia as we slept through the recent solstice.

What drives the birds to leave, and eventually return, is their innate response to the changing photoperiod, which is an artifact of the earth's tilted axis. And you might guess that the closer to the North Pole (or South Pole) that a species breeds, the more responsive it needs to be to changing sunlight simply because there is so little time to get all that needs to be done to successfully reproduce and mature.

I read with great interest a 2009 paper published in the *Journal of Fish Biology* that examined precisely that question in three-spined sticklebacks, a fish common in lakes on the Kenai Lowlands. Researchers from the University of Oregon challenged sticklebacks caught in Anchorage and in Oregon with different photoperiods under climate-controlled laboratory conditions. Sure enough, reproductive maturation was strongly affected by day length for male and female sticklebacks from Alaska, but not from Oregon.

So, be glad the earth is tilted in its celestial plane, be glad that the sun was over the Tropic of Capricorn a few days ago, be glad for longer days and be glad that the birds know this, too. All glad tidings as we settle into the Christmas weekend!

*Dr. John Morton is the supervisory biologist at Kenai National Wildlife Refuge. Find more information about the refuge at <http://www.fws.gov/refuge/kenai/> or <http://www.facebook.com/kenainationalwildliferefuge>.*

## Kenai Refuge highlights in 2016

by John Morton



*The 3-mile-long Marsh Lake Trail was newly completed in 2016 on the Kenai National Wildlife Refuge. The logs came from trees removed as part of treatments to reduce fuels around Sterling this past summer.*

In thinking about highlights in 2016 for the Kenai National Wildlife Refuge, I'm reminded yet again that what is valued is ultimately in the eyes of the beholder.

If you're a hunter, you'd be happy to hear there were 23 fires this past year. Most were flare-ups from the 2015 Card Street Fire, but some were from the 2014 Funny River Fire. Most moose hunters know that when wildfire burns down to mineral soil, spruce forest converts to birch and aspen, two hardwood species that help sustain moose during the winter. Biologists from the Refuge and the Alaska Department of Fish & Game shared GPS data from collared moose cows in Game Management Unit 15B this past year to not only understand how moose are responding to the Funny River Fire, but also to understand how moose use the urbanizing landscape on the western Kenai Peninsula.

If you're someone who likes to hike, you'll be glad to hear of a new trail in the Refuge's Skilak

Wildlife Recreation Area. The Marsh Lake trail winds its way along a whimsically implemented dozer line that helped stop the Card Street Fire. Though the line may not be direct, its destination is a direct result of strategic firefighting. Marsh Lake made an ideal anchor for fire suppression operations due to the network of wetlands surrounding its cool banks. The Refuge trail crew, a Student Conservation Association high school crew, and fire management personnel came together and pulled off the most complex trail project to date on the Refuge. More than 600 linear feet of heavy timber was cut from the Three Johns Road thinning project and brought to the end of the 3-mile trail. After logs were debarked and spiked into place, 100,000 pounds of rock and dirt had to be hauled in freighter frame packs to the lake. What resulted was a turnpike that keeps you out of the wetland goo for more than 300 feet!

On the other hand, if you're a homeowner in the central peninsula, you'd be relieved to know that Refuge fire staff worked with Alaska State Division of Forestry, Cook Inlet Region, Inc., Chugachmiut, Kenai Peninsula Borough, and ADF&G to create defensible space around Sterling. The partnership completed nine fuels treatments on more than 220 acres either mechanically or through prescribed fire as part of the Sterling Community Wildfire Protection Plan. Strategic fuel reduction around communities adjacent to refuge lands gives the Refuge Manager a little more wiggle room to allow lightning-caused wildfires to run, a desired outcome if communities are not put at risk.

And because the Refuge landscape has changed so much in recent years due to the effects of wildfire, spruce bark beetle outbreaks, and a rapidly warming climate, you'll be glad to know that biologists and remote sensing specialists from the Forest Service, Kenai Fjords National Park, Kenai Peninsula Borough, and others have partnered this past year to begin remapping the landcover of the Kenai Peninsula (last done a decade ago). A new tool being used in combination with satellite imagery and on-the-ground vegetation data is high resolution aerial photography, brought into focus with better digital cameras and Structure from Motion, a computer-intensive software capable of producing orthophotographs and 3-D spatial surface data.

Managing the Kenai Refuge, as with many public lands, requires multiple hands to help address the various demands for its natural resources and access to open space. It's easy to forget that the refuge is not "just" 2 million acres of wildlands. As one of only two refuges on the Alaska Highway system, Kenai Refuge also serves local residents, half of Alaskans who live in the Anchorage area, and the many tourists who drive

the ALCAN or choose to rent cars or RVs while here in Alaska.

An artifact of these sometimes competing demands is that the Refuge has a large human footprint. Consider that Kenai Refuge encompasses more than 100 miles of maintained road, 110 miles of maintained trails, 150 miles of utility and transmission lines, 14,000 acres of lands leased for commercial oil and gas extraction, 16 public use cabins, 15 established campgrounds, two canoe systems, a new visitor center, and the various facilities that provide space to educate local youth as well as office space for administrative staff. In 2016, Kenai Refuge supported over 60 permanent and seasonal staff, interns, volunteers and students to help ensure your public lands and facilities were managed in such a way to be safe and welcoming, but as minimally intrusive as possible to the surrounding natural landscape.

As a final highlight for 2016, the Kenai Refuge celebrated 75 years of conservation on Friday, December 16<sup>th</sup>. Sponsored by the Friends of Alaska National Wildlife Refuges, National Wildlife Refuge Association, Alaska Geographic and U.S. Fish and Wildlife Retirees Association, more than 200 guests attended this evening event that showcased the Refuge's diverse landscapes through artwork by volunteer photographers Tom Collopy and Mary Frische, family activities and a centerpiece cake that, well, took the cake. And, at the end of the day, it's good to see the refuge through the eyes of artists.

From the entire Kenai Refuge staff, best wishes to all of you for a peaceful and joyful holiday season!

*Dr. John Morton is the supervisory biologist at Kenai National Wildlife Refuge. Find more information about the refuge at <http://www.fws.gov/refuge/kenai/> or <http://www.facebook.com/kenainationalwildliferefuge>.*